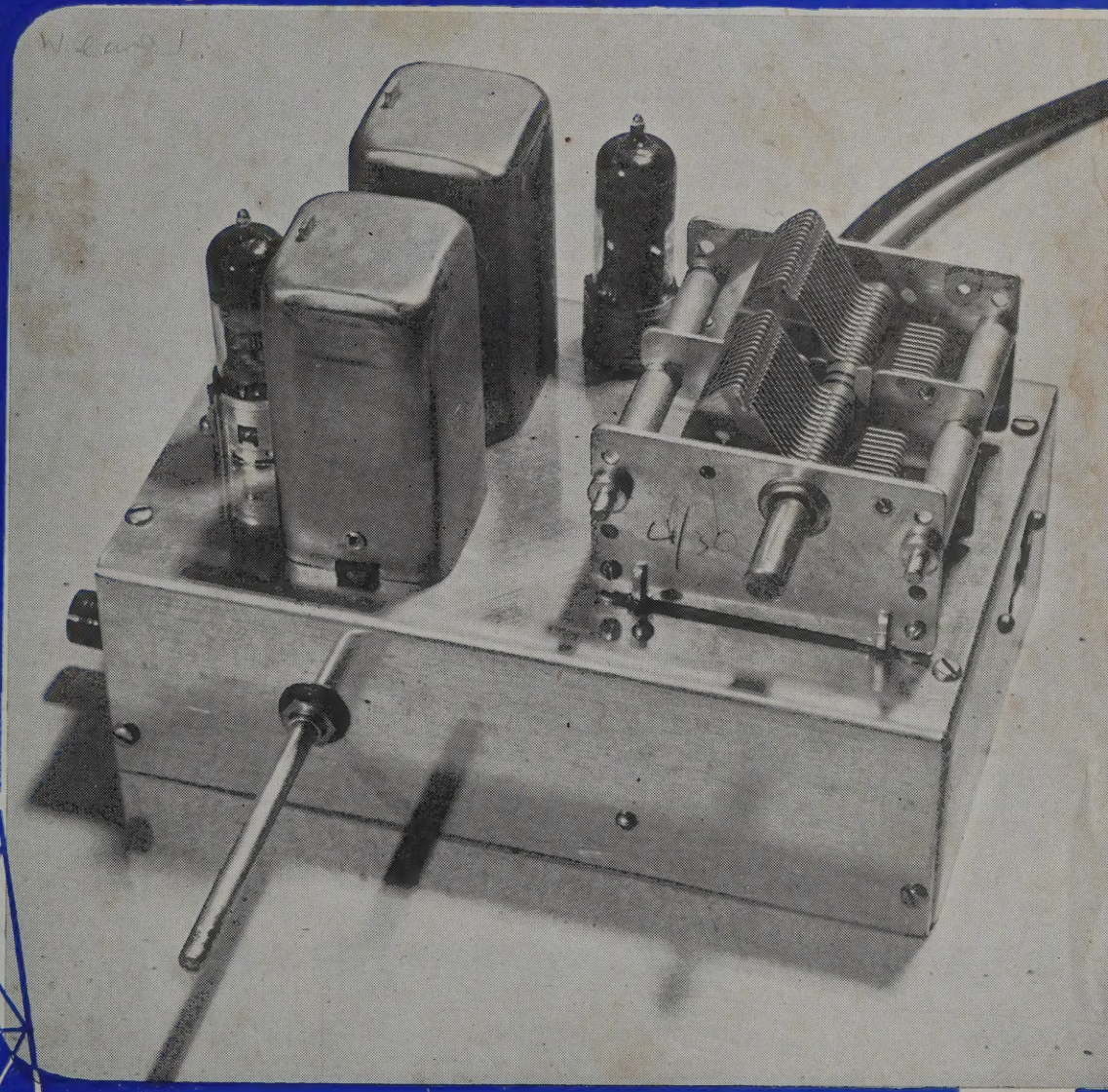
RADIO and ELECTRONICS

ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND



AUGUST 1st, 1952 VOL. 7, NO. 6.

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1/10

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RADIO AND ELECTRONICS

Vol. 7, No. 6 — 1st August, 1952

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OUR COVER

This month's cover features a view of the high-gain low-noise pre-selector featured on page 4 of this issue.

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IS HIGH-FIDELITY BUNK?

In one of our British contemporaries, there currently appears an advertisement which is an extremely interesting essay in applied psychology. Like all advertisements, of course, it is trying to sell something, and like most of them, its approach is based on the seller's idea of the mental processes of the prospective buyer. At the same time, though, it is pretty revealing on the subject of the seller's line of thought, unless the gentleman concerned has his tongue firmly in his cheek the whole time.

Briefly, the story is this. Various people in America have written to the advertiser with a tale of woe to the effect that, having spent untold sums on equipment, they still can't get anything out of an L/P record that sounds to them like real music. The inference is that if the same people had used this firm's equipment, all would have been well, and that the vastly expensive high-fidelity equipment the American enthusiasts were so disappointed in, was no good. At the same time, they managed to squeeze into the script one of the perennial gibes at the term "high-fidelity."

Now without in the least wishing to take sides, all this is entertaining, to say the least. In the first place, if one is in the remarkably happy position of being able to spend large sums on (presumably) high-grade American audio equipment, and yet one cannot derive pleasure from L/P records, there must be something wrong somewhere. The writer is not one of those who professes either that nothing good ever came out of America or that nothing good ever came from anywhere else. Both the British and Americans know enough about the design and construction of audio equipment to produce something pretty good, especially when money is no object, and it seems that either the complainant bought expensive gear that was not as good as its price said it should have been, or else he was hard to please, almost to the point of being impossible!

The part about the said advertisement that caught the present writer's eye, however, was the bit where the firm disclaimed having anything to do with "high-fidelity" equipment, on the ground that it had nothing to do with "medium" or "low-fidelity" gear, either.

This latter seems like a quibble on words, and hardly worthy of one who claims to have first-class equipment to sell, but it does illustrate a trend towards the "debunking" of the term "high-fidelity." True, it is not a good term from any point of view, and least of all from that of language, but at least it has come to mean something. Just what it means really depends on what side of the fence you are on. If the selling side, it means "equipment giving the greatest possible realism in reproduction." If you are on the receiving side, it probably means "something that makes some pretence to being better than the average radio set, but which is not necessarily so." Both definitions can be both honest and unbiased, for as long as the maker of such equipment uses his definition as a standard to be aimed at, but never achieved, the consumer will have less and less reason to qualify his definition, in order to match his experience of manufacturers' claims.

It is quite true that there is a great deal of nonsense talked and written on the subject of the electrical reproduction of music; in these times, when the public seems to be getting quality-conscious to a hitherto unheard of degree, it is to the benefit of all concerned that as little of it should be written as possible. Even for those who have some technical background, it is difficult sometimes to see just where the spate of published literature about high-quality reproduction leads, so it is only to be understood if non-technical people can spend good money on good equipment, and still not get what they want. Boiled down to essentials, the thing is fairly clear-cut. To our way of thinking the essentials are these:—

(1) The reduction to as low a level as possible, of all forms of distortion.

(2) The improvement of signal-to-noise ratio.

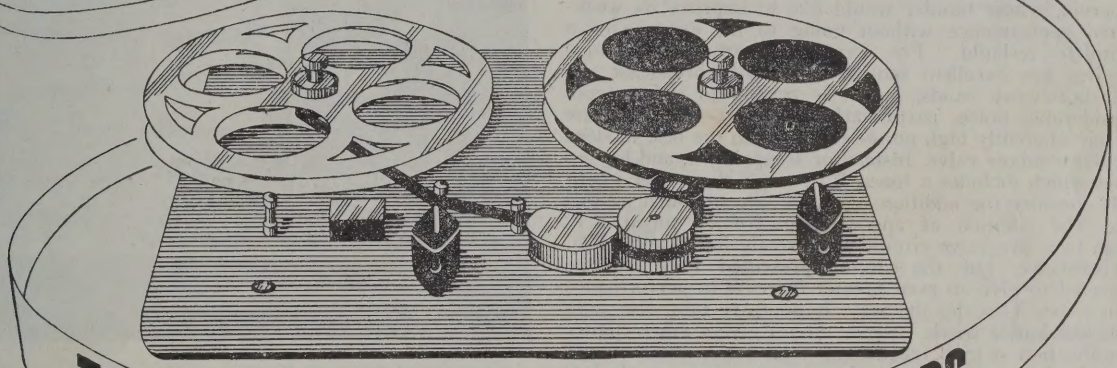
(3) The extension of frequency response.

It will be noticed that extension of the frequency range comes last. If we have learned anything in the last twenty years, it is that in improving reproduction, the first and greatest effort must be directed towards reducing distortion. Extension of the frequency range and the dynamic range can be undertaken solely as a result of decreased distortion. Perfection in musical reproduction is like perfection in many things, in that the nearer one approaches it, the more glaring do imperfections become. For this reason, the unsuspecting purchaser of high-quality audio equipment can be completely at the mercy of the catalogue or the salesman. For instance, who will tell him that the amplifier and speaker system for which he is paying so much will merely show up the faults in the pick-up he proposes to use with them? And who will tell him that the extra £50 he is spending on a loudspeaker will get him absolutely nowhere unless he makes equally highly priced modifications to the rest of his equipment? Certainly not the catalogue or the salesman. So who is to blame him if, after that, he decides for himself that high-fidelity, high-quality, or what you will is bunk?

What is all boils down to is this: audio is a specialized branch of electrical engineering, and any electrical engineer will tell you that in his profession there is precious little room for the perfectionist. As with all engineering projects, economics is often a more potent design factor than all the theory in the world, however elegant, and however correct. So it is with audio work. If one has unlimited money to spend, one can demand the very best and get it. (The only difficulty here is that at no stage of audio development have the pundits decided what is the best technical practice.) If one's capital is limited, then the only proper approach is that of the engineer, who looks at a job as a matter of fulfilling a specification as well as possible, with the least outlay. True it is, that the specification is still somewhat indefinite, but we are finding out more about it every day, and it is not impossible, even now, to design audio equipment, to a limited budget, that will sound not very much less real than gear costing several times as much.

There are some questions upon which we have not had room to touch, such as how much should the designer "pander" to the listener's idea of good audio quality, and other interesting topics, but these will have to wait for a subsequent editorial. In the meantime, we would like to go on record as believing that as long as "high-fidelity" means honestly attempting to give the music-lover something a good deal better than the reproduction to which he has been accustomed, by force of circumstance, then we are in favour of it, and it is not "bunk."

Qualitape



THE BEST BUY IN TAPE RECORDERS

★ **THE IDEAL GENERAL PURPOSE UNIT**

★ **LOW PRICE — GOOD QUALITY**

Available as a Complete Deck or in Kit Form (exclusive of tape). Will take 3M (Minnesota Mining and Mfg. Co.) tape or other standard tapes. Tape speed approximately 7½ inches per second. Extra pulley wheel can be supplied to increase speed for high fidelity. Working instructions, wiring diagrams, and suggested amplifier circuit included in kit. Deck available mechanically assembled requiring only wiring to motors and main switch which are provided, also record/playback head.

SPECIFICATIONS

TOP PLATE: 12¾ in. x 10¾ in.; finished in Grey Crackle; overall depth, 5 in.

MOTORS: Two A.C. One direct drive on to capstan; other high-speed rewind.

CAPSTAN: Heavy solid brass. Engine turned in one piece, guaranteeing perfect accuracy; rotates on half-inch ball-bearing. Rubber drive fitted. Cemented and finally ground in position.

SPOOL SPINDLES: Of high-quality steel, revolving on solid gunmetal brackets on ball-bearing centres.

TAPE GUIDES: Finished in chromium.

MAGNETIC ERASE HEAD: Designed exclusively for Tape Recorder use.

RECORD/PLAYBACK HEAD: Low impedance; circular mumetal stacks of 0.008 thick laminations; built up to ¼ in.; wound to close tolerance and set in rubber with outer case finished in chromium.

CLUTCH: Adjustable spring-loaded clutch on each spool.

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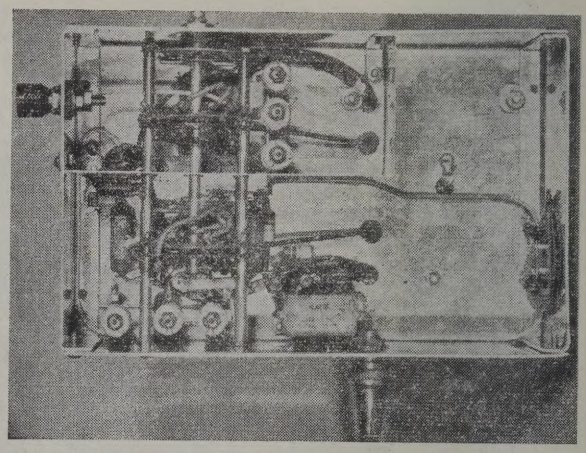
A High-Gain Low-Noise Pre-Selector

For those who want to get the last ounce of usable gain from their receivers, or who wish to make an already fair receiver into a very good one, we recommend this high-gain R.F. pre-amplifier circuit, using the modern "cascode" arrangement to give the amplification of a pentode stage, with the low noise of a triode.

INTRODUCTION

If often happens that a receiver which is quite good in many respects just lacks that extra "punch" which makes such a difference to the reception of weak signals. The set may be a good commercial one, or a home-built superhet, whose builder would like to improve its weak-signal performance without going to the expense of a complete re-build. For example, many a five-valve receiver has excellent sensitivity on both broadcast and the short-wave bands, but it is certain to suffer from considerable noise, particularly on short-wave, because of the inherently high noise-level of even the best modern oscillator-mixer valve. Instead of scrapping it, and buying a set which includes a tuned R.F. stage, the owner might well consider the addition of a pre-selector such as this one. The addition of any well-constructed tuned R.F. stage to a five-valve circuit will greatly increase its R.F. performance, but the circuit presented here can be expected to give an even greater increase in performance than most. This, by the way, is no fairy tale. Not only does the double triode cascode circuit give a much higher amplification at high frequencies than does a conventional pentode, but at the same time, it generates much less noise, so that between the two, we have not only an increase in overall amplification, but an increase in the *effective* sensitivity. By this, we mean that it will enable weaker signals to be read than is possible on the same receiver, without the pre-selector.

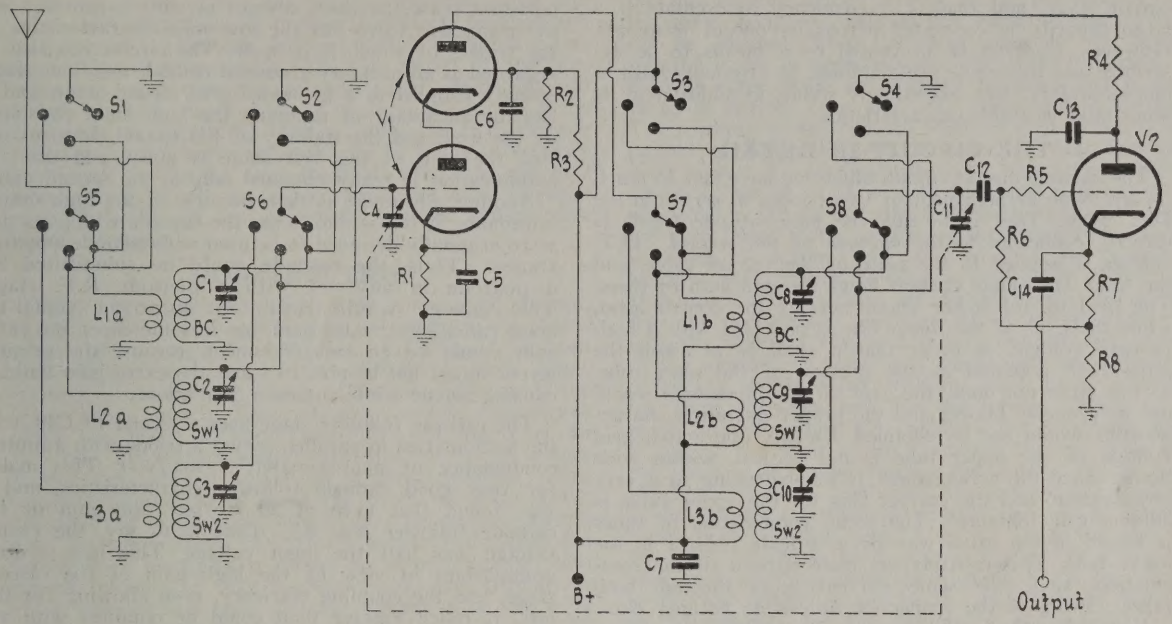
If the weakest possible signals are to be received intelligibly, a receiver must fulfil two requirements. First, it must generate as little noise as possible. It is hardly the place in an article of this kind to delve deeply into the theory of the matter, for it is quite abstruse, and only its practical manifestations will be of interest to many readers. In spite of this, however, some slight knowledge of what limits the sensitivity of a receiver is very useful, if only because it enables one to see whether any worth-while improvement can be expected in any particular case. The noise generated by the receiver is of two kinds. The so-called thermal agitation noise, generated spontaneously in resistors, tuned circuits, and so on, and shot-effect noise, generated by the valves themselves. In general, it is not possible to do very much about the first kind of noise, at any rate in a general-coverage receiver working at medium and high frequencies. This second, however, is under the control of the designer of the set, because he is able to make decisions which will determine whether the set generates more noise than it could be made to do. Mostly, the choice of valves is the determining factor, and in general-purpose sets, such as all-wave domestic receivers, the designer is unable to make use of the valves which are the best, from the low-noise point of view, because such valves are usually quite unsuitable on other, quite unrelated scores. For example, the high-gain, low-noise pentodes beloved of the designers of V.H.F. receivers of one sort or another are frequently right out of the running, simply because it is difficult, and even impracticable, to apply A.V.C. to them. As a result, about the best the commercial set can hope for is a tuned R.F. stage, using a pentode such as the 6K7, EF39, etc., in front of a triode-hexode converter. Luckily, such a set-up can give very good performance indeed—certainly as good as any domestic receiver ordinarily needs—and it is only when the question of whether such things can be improved on arises, that anyone need trouble himself about receiver noise.



Underneath view of the pre-selector, showing aerial terminal on the left, the output cable connecter on the back of the chassis (front in the photograph) and the power socket on the right.

The second requirement of a set, once it has been designed to produce as little noise as possible, is that it must have enough amplification to enable what little noise it does make, to be heard in the speaker or phones. Otherwise, the whole object of reducing the set noise is not fulfilled. This might at first seem like a contradiction in terms, but it is not so. Suppose that the set, as originally constituted, had enough amplification to bring the set noise well into audibility; then in that case, any signal which is sufficiently louder than the noise to be intelligible, must be copyable. If now we do something to the set which reduces its own noise so much that it can no longer be heard, then it will no longer be possible to read the weakest signal that the set can receive with a good enough signal-to-noise ratio to be intelligible. The only thing to be done in such circumstances is to add gain to the set. Nor does it matter in the least, whether the extra gain is at audio frequencies, at I.F., or at R.F.

The case we have been describing is hardly a practical one, for it woud have to be a phenomenally bad one for such a happening to occur. A more likely example is one already mentioned, namely that of the set which starts off with an oscillator-mixer valve. In this one, there is probably plenty of gain. That is to say, if the aerial terminal is short-circuited, and the gain control turned full up, a hissing noise will be readily apparent. This noise is the amplified shot noise from the valves, and



possibly contains some thermal agitation noise from the first tuned circuit. But the bulk of it will undoubtedly be due to the first valve. Now it is quite possible that the weakest readable signal on the short-wave bands in a set of this kind is some 15 or 20 microvolts. If it were possible to change the mixer tube for another, which had the same gain, but only a tenth the noise, then the weakest usable signal would immediately become 1.5 to 2 microvolts—a great improvement. Unfortunately, such a tube does not exist, and so we are faced with the addition of a stage of R.F. amplification. At first, it might seem as if this could do no good, because the mixer noise is still present, even if we stick on several R.F. stages ahead of it, but this is false reasoning. If the R.F. stage we use has appreciable amplification, and if it makes much less noise than the mixer tube, it will have brought the signal up to a high enough level for it to over-ride the mixer noise, and the set behaves as if the mixer noise had been eliminated. Also the addition of the R.F. stage automatically provides the extra gain needed because of the reduced noise level.

PROVIDING AN ADDITIONAL R.F. STAGE

Although a high-gain, low-noise R.F. stage is itself not a very difficult thing to provide, adding it to an existing receiver is not the easiest of things to accomplish successfully. It is very rarely possible to build the extra stage into the original set, because there is seldom room on the chassis for it. An extra section would have to be provided on the gang condenser, to mention only one thing, and even if this were possible, it is most likely that the layout of parts would not allow the change to be made in a satisfactory manner. It is essential, then, that the extra stage be built as an outrigger, and tuned separately from the main receiver. The extra tuning control is very little hardship when operating the set, because the selectivity of an R.F. stage is never high enough to cause difficulty. In short, searching for stations can be done over quite a range of the main dial without having to re-tune the pre-selector, and when a station is found, the pre-selector can be quickly and easily brought into tune with a turn of its tuning knob.

V_1, V_2, ECC40. V_2 has sections connected in parallel.
$L_{1a, b}$ and $_c$, triple-wave aerial coil.
$L_{2a, b}$ and $_c$, triple-wave R.F. coil.
S_1 to S_8, wave-change switch.
C_1, C_2, C_3, C_8, C_9, C_{10}, 3–30 $\mu\mu$f. Philips trimmers.
C_4, C_{11}, 2-gang condenser to suit coils.
C_5, C_6, C_7, C_{13}, 0.05 μf.
C_{12}, 250 $\mu\mu$f.
C_{13}, 500 $\mu\mu$f.
R_1, 300 ohms.
R_2, 100k.
R_3, 150k.
R_4, 10k.
R_5, 200 ohms.
R_6, 250k.
R_7, 1000 ohms.
R_8, 50k.

Fortunately, the question of efficient coupling between the amplifier stage and the main receiver can be readily resolved by the use of a cathode follower, which is by far the most satisfactory wide-band coupling device that can be used for the purpose. Accordingly, the whole circuit consists of the cascode amplifier circuit, feeding via a tuned circuit into the grid of the cathode follower output stage. In this way the pre-selector is given only one stage of amplification, but two tuned circuits, so that the selectivity is as good as that of a set with two built-in R.F. stages. Incidentally, the performance of the cascode stage is so good at 20 mc/sec. that its gain, too, is as good as many two-stage R.F. amplifiers at this frequency. The amplification from the aerial terminal to the grid of the cathode follower was measured as 50 times, at the high-frequency alignment point of 18 mc/sec. On the two lower bands, the gain was remarkably high, being over 150 times, without any sign of instability! There is only one difficulty about the cathode follower

output stage, and that is its tendency to oscillate if a large capacity is connected across its output terminals. However, this can be prevented by a means to be described, and the whole pre-amplifier, as originally built in our laboratory, was exceedingly stable, in addition to its other most desirable characteristics.

THE CIRCUIT IN DETAIL

The cascode circuit, about which we have had so much to say, is an arrangement of two triodes in series, in the D.C. sense. That is to say, the plate of one triode is directly connected to the cathode of the second. H.T. voltage is applied to the plate of the second valve, and the same D.C. plate current flows through both of them. The grid of the lower triode acts as the control grid, while the grid of the upper one is provided with a high positive voltage, in order that it shall be at about the same D.C. potential as the cathode of the same tube. If this were not done, the grid of the upper tube would not be properly biased, and the proper operating characteristics would not be obtained. Luckily, the actual grid voltage of the upper tube is not critical, within wide limits, since the arrangement is self-balancing to a very large extent, and the correct bias for the upper valve is automatically obtained. The series combination of tubes is biased in the usual way by a cathode resistor in the lower half. This controls the plate current of the combination, since the same current flows through both tubes. Owing to the connection, it can do nothing else.

Now this rather peculiar set-up has several advantages. If curves are drawn of plate current against plate voltage, for various grid voltages, a family is obtained that looks for all the world like the plate curves of a pentode. The main difference is that with the cascode, there is slightly more slope to the main parts of the curves than with a pentode, whose curves are almost flat. However, the cascode curves show that the combination of valves does behave very similarly to a pentode, in that it has a very high plate impedance, and a mutual conductance that is identical with that of each triode. We consequently arrive at a "synthetic" pentode, of high gain. But there is better to come. It is well known that pentodes create much more shot noise than triodes, and also that the main source of additional noise in the pentode is the screen current, since random division of the electrons between the screen and the plate result in noise that is similar in character to the ordinary shot noise, which is due to the fact that the current of electrons making up the plate current is not a steady flow, but is made up of individual electrons, whose rate of flow varies slightly at all times. These variations in current from moment to moment constitute the shot noise.

In the cascode circuit, the grid of the upper valve is by-passed to earth, just like the screen-grid of a pentode, but since it is held negative with respect to its own cathode, it cannot draw any current, and so we have a sort of pentode, in which the screen-grid draws no current. It is impossible, therefore, for there to be any partition noise, as there always is with a pentode, and the composite valve has the low-noise characteristics of the triodes of which it is made. The circuit can also be regarded as an ordinary grounded-cathode amplifier stage, directly coupled to a grounded-grid second stage, and it has the advantage of retaining the high input resistance of the first, and the stability of the second. It turns out that the gain of the first stage is unity, and that the amplification is really obtained only in the second valve.

Another advantage is that, because of the high output impedance, it is possible to use the cascode with coils that were originally designed to be used with pentode amplifier stages. Thus, the cascode could be substituted for a pentode in any set with a pentode R.F. stage. This change would result in improved signal-to-noise ratio, and greater gain, but in some cases, the extra gain would be an embarrassment, because the original layout might not be able to stand the extra gain without causing regeneration, and even oscillation.

The cathode follower stage uses a second ECC40, with the sections tied in parallel, giving a triode with a mutual conductance of approximately 7 ma./volt. This makes for very good cathode follower characteristics, and it was found that even at 20 mc/sec., the gain of the cathode follower was 0.5. That is to say, the output voltage was half the input voltage. This loss is quite unimportant in view of the high gain of the cascode stage, and the coupling efficiency, even allowing for this loss, is much greater than could be obtained with any other sort of coupling circuit between the amplifier and the aerial terminal of the receiver. The grid-stopper is a very important component in the cathode follower circuit, in spite of its insignificant appearance. It can be shown that if a capacity is shunted across the output terminals of a cathode follower, the stage becomes regenerative. In practice, this is found to be so, because if the input is from a tuned circuit, a cathode follower that is completely stable can be made to oscillate simply by connecting a condenser from cathode to ground. Here we automatically have a fairly high capacity across the cathode, because of the shielded output cable. The output must definitely be shielded, otherwise oscillation can take place because of coupling between the input and output leads of the unit. Even if low-capacity co-axial cable is used for the output lead, the capacity is likely to be as high as 75 $\mu\mu$f. and if ordinary shielded hook-up wire is used, the capacity can be as high as 250 $\mu\mu$f. even for a quite short length of cable. It is fortunate, therefore, that there is a cure for the regenerative tendencies of the capacitatively loaded cathode follower. It consists simply a inserting a grid stopper of the correct value. The size of the grid stopper depends on the frequency range to be covered by the cathode follower, and needs to be larger the lower the low-frequency limit. For high frequencies, a stopper of 25 ohms might be found sufficient, but here, we have to cover down to 550 kc/sec., so that a much larger one is necessary. The value finally used was 250 ohms. It is important that the output cable should have

Poly-Q

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Coil Assemblies incorporating Polystyrene Adjustable Slug Coils available in dual- or triple-wave. Gang, Dials, Chassis to match.

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as little capacity as possible, because the greater the capacity, the larger the grid stopper that has to be used, and in this case, the cathode follower loss at the *highest* frequency becomes excessive. The lab. model of the pre-selector used a piece of co-axial cable about 18 in. in length, and this had a capacity of 75 $\mu\mu$f., for which the 250 ohms was perfectly effective, with the H.F. cathode follower "gain" begin reduced only to 0.5, as previously mentioned. It can be seen from all this, that the grid stopper here is not just a precaution, but is an essential part of the design, and cannot be left out without dire results accruing.

CONSTRUCTION

While the construction of the unit is not at all difficult, it is most essential that it be done according to the photographs of the original model. Note that a shield has been used across the socket of the ECC40 amplifier stage, entirely separating the wiring of the two sections of the wave-change switch. The coils are standard triple-wave units, one being an aerial assembly, and the other an R.F. one. The wafer switch is provided with extra wafers so that the coils not in use can be short-circuited. This prevents interaction between the three windings which are mounted in the same shield can. The earthing switch does not short-circuit the high-frequency coils when the broadcast or intermediate ranges are in use, because these cannot resonate in such a place as to cause trouble on lower bands. The only shorting needed is on the coils lower in frequency than the one in use at the moment. If the shorting is not done, it might be found that the next lowest coil, with its trimmer, but without the gang condenser across it, resonates within the coverage range of the coil being used. If this happens, it acts as a wave-trap, causing high absorption of energy from the coil in use at one particular frequency, at which the gain of the pre-amplifier stage would almost disappear. There is no need for a cross-socket shield on the cathode follower valve, because in this tube the gain is less than unity, and a shield cannot affect the regeneration that arises because of output capacity. This is something connected with the actual operation of the valve itself, and is in no way dependent on external coupling. The gang condenser has been laid on its back so as to shorten the all-important grid leads. The earthing of the gang is important. It was not mounted on insulating grommets, so that the frame is earthed by the mounting bolts. These should not be relied upon for the R.F. earthing, however, and the wipers should be earthed by taking some flexible braid back to the place where the common earth-points for the tuned circuits are situated. The pieces of braid are soldered to the wipers before the gang is mounted, and pieces of spaghetti insulation are slipped over the braids. The gang is then mounted, and the insulated braids are taken through chassis holes. The braids are then run along to their respective earthing points, where they are solidly soldered. This procedure ensures that R.F. currents flow only through the braid, and not through the chassis, in getting back to the earthed ends of the coils. Apart from this, there are no special wiring dodges to be observed.

ALIGNMENT AND USE

When the unit has been wired up, the wiring should be checked over for mistakes, especially round the wave-change switch, which is the only part likely to cause any confusion. After this, power can be attached, and the unit turned on. The alignment is very simple, and can be done quite without special instruments. The output is attached to the aerial terminal of the main receiver, and this is turned on. First of all, do not connect an aerial to the pre-selector, and tune the receiver to 2YA. If necessary, this can be done before turning on the pre-seelctor, with the set's aerial lead held in one hand, so that a signal can be received. Then the gang condenser of the pre-selector is set to approximately the correct position for 2YA to come in on an ordinary receiver—that is about 10 to 20 degrees from the fully closed end of the gang. The trimmer of the cathode follower grid circuit is then peaked up. Then, the aerial trimmer is peaked for maximum output. To do this properly, it may be necessary to attach a foot or so of wire to the aerial terminal of the pre-selector, but do not attach the aerial proper. When it has been found that a position of the trimmers can be had at which the whole thing tunes to 2YA, the receiver is tuned to some station as close as possible to 1400 kc/sec. If no station is available, set the dial to this point. Now tune the pre-selector, and note where it comes into tune with the receiver. This spot is very easily found, because of the increase of noise as it comes into tune. The point of tuning should occur with the main gang about 20° out from the open end. Set the tuning control at this point, and then tune the trimmers for maximum noise. If one or the other of the trimmers will not peak, shift the gang a little, and re-tune the station, or the noise, whichever is being used, with the trimmers. Eventually, by this means, a setting of the main dial will be found at which both trimmers peak. They are set at the peak and left. The broadcast band is now aligned. It is not possible to do anything about the tracking of the two circuits at the low-frequency end of the dial, because there are no adjustments for the inductance of the coils. The trimmers must be set at the high-frequency end of the dial, and then left. This is just what is done in aligning the aerial and R.F. trimmers of an ordinary set, and the condensers and coils can be relied upon to track well enough over the whole band.

Aligning the higher bands is exactly the same in procedure, except that the alignment frequencies are 6 mc/sec. and 18 mc/sec. respectively.

A word of warning about the aerial lead on the receiver. Most domestic sets have a long aerial lead issuing from a hole in the chassis, and the natural thing to do would be to just attach this to the centre conductor of the output cable of the pre-selector. However, the outer shield of the cable *must* be solidly earthed to the chassis of the set by as short a wire as possible. Also, the long aerial lead must not be allowed to approach the aerial itself, or the high gain between the two leads (the gain of the pre-selector) will cause the whole thing to go into oscillation, even if the pre-selector itself is quite stable. The best way to guard against this sort of thing is to install an aerial terminal on the chassis of the set, so that no unshielded aerial lead issues from the chassis at all. Then, as close to it as possible, an un-insulated earth terminal is installed. When this is done, the open lead from the shielded cable need be only about an inch long, and oscillation through coupling between the input and output leads is very unlikely. If the set already has aerial and earth terminals, this should be unnecessary, but whatever you do, see that the unshielded connection from the aerial terminal to the centre conductor of the output cable is as short as possible.

Use of the pre-selector does need a little thought sometimes, and it is quite possible to get effects that to the uninitiated, might make it seem as if the unit were playing up. For example, the signal from the local broadcast stations is often quite strong enough to overload the pre-selector, causing very great distortion. This need not cause any difficulty, because the pre-selector is not needed for the reception of local stations anyway, and it can either be disconnected, or simply de-tuned until the dis-

(Concluded on Page 48.)

Cavendish Laboratory Radio Chief Visits New Zealand

This country was recently privileged to receive a visit from one of Great Britain's most distinguished scientists connected with research work in radio. We refer to Mr. J. A. Ratcliffe, head of the radio department of the Cavendish Laboratory in Cambridge. While in this country, Mr. Ratcliffe held discussions with many of our scientists and engineers whose work is connected with radio propagation, and visited practically all of our institutions whose work is largely bound up with physical science. While in Wellington, Mr. Ratcliffe attended a conference with the New Zealand Radio Research Committee and representatives from various units concerned with radio research and development. He gave a lecture to the Physics Section of the Royal Society of New Zealand on "Movements and Irregularities in the Ionosphere," in which he gave an account of work conducted by him in the Cavendish Laboratory over a period of several years, up to the present time. It is intended to publish a fuller account of this most interesting lecture in a later issue of this journal.

Mr. Ratcliffe is one of the world's acknowledged authorities on the ionosphere, and his visit must have been an inspiration to those who were able to meet him and discuss their work with him. For those of us who have to rely on published accounts for our knowledge of the most recent developments, it is most stimulating to meet and hear in person a man of his standing in our own field of endeavour, and it is a very great pity that visits by Mr. Ratcliffe, and others like him, are not more freqeunt. The following brief account of his career in radio research will give readers some idea of the extent of his interests and of the important researches upon which he has been engaged.

Commencing research at the Cavendish Laboratory, Cambridge, under E. V. Appleton (now Sir Edward) in 1924, J. A. Ratcliffe soon became involved in the experiments which Dr. M. A. F. Barnett (now of the Meteorological Office in Wellington) and Appleton were doing on radio waves reflected from the ionosphere. After Barnett's return to New Zealand and Appleton's departure for London as Professor at King's College, Ratcliffe was left at Cambridge, with one or two others, doing research work on the ionosphere. During the period 1927–1939, he worked with a series of different research workers, including Dr. F. W. G. White, who was later Professor at Christchurch, and is now Chief Executive of the Council of Scientific and Industrial Research in Australia, and Dr. J. L. Pawsey of the Radio Physics Laboratory in Sydney.

On the outbreak of World War II, Ratcliffe joined T.R.E., the research and development laboratory of the British Air Ministry. There he was concerned with the introduction to the Service of the new centimetre radar equipments which were being developed, training teams of scientists, biologists as well as physicists and engineers, to do expert maintenance on the new equipments, so that frequently an experimental apparatus could be used in operations against the enemy long before its design was properly complete.

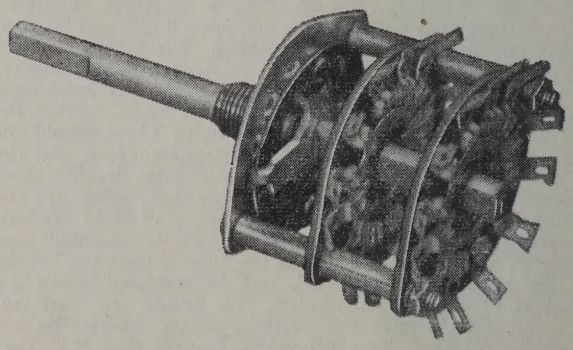
After the war, he returned to the Cavendish Laboratory where, with the help of some of his old colleagues, who had similarly been engaged on war work, he restarted the radio research on the ionosphere. In this he was assisted by able research students with wide experience in radar from the Dominions, especially New Zealand and Australia.

This work has done much to solve some of the problems of the propagation of radio waves through the ionosphere. Prior to the war, Ratcliffe was particularly interested in the absorption of waves and in the collision frequency of electrons in the ionosphere, and also in the propagation of very long waves. Since the war, the work on very long waves has been continued and extended, so that now there is a fairly good knowledge of the propagation of waves of frequencies between 16 kc/sec. and 150 kc/sec. over distances up to about 1000 km. A paper contributed recently to the Journal of the Institute of Electrical Engineers of the Cambridge School of Workers has been awarded the Duddel Premium of the Insttiution.

In conjunction with a New Zealander, I. J. Shaw, Ratcliffe has advanced our knowledge of that form of interaction of radio waves known as the Luxembourg effect. His team of workers has disentangled the problems associated with the fading of a single ionospheric wave, and in the process have shown the irregularities in the ionosphere, and the way in which winds can be discovered and measured at heights between 90 and 450 km. by simple radio methods. The methods are now being used at the Dominion Physical Laboratory to measure these winds over New Zealand, and to compare them with the measurements in Cambridge.

As a result of a recent visit to America, Ratcliffe has shown how it is possible to use existing ionospheric records to determine the way in which the electrons are distributed with height in the ionosphere. By this means he has shown that the F2 layer, usually supposed to behave in an irregular manner, is, in many respects, much more uniform in its behaviour than has often been supposed.

OAK SWITCHES



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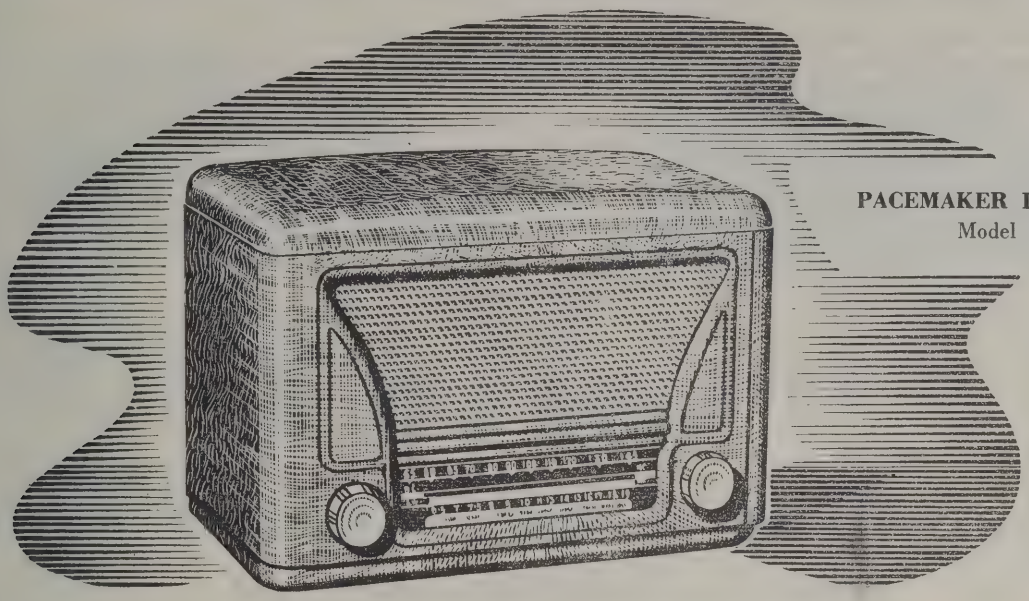

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A FREQUENCY RECORD WITHOUT A TURNTABLE

When building equipment for record playing, it is essential, unless someone has worked out the details for you, to do a frequency run on the compensation stage. This cannot ordinarily be done without a frequency record, but the circuits given here show how test records can be dispensed with, as long as an audio oscillator is available.

INTRODUCTION

Of recent months, this journal has had a good deal to say about the circuits needed for playing 78 and L/P discs, with various kinds of pick-up. When frequency-compensation circuits have been built, it is always desirable to test their response curves, to make sure that in conjunction with the pick-up and the records, the over-all response is flat. In the ordinary course of events, a constant frequency record is needed. For 78 r.p.m. records, such discs can be bought, although they are a little difficult to come by at times. For L/P records, on the other hand, there do not yet seem to be any test records issued by the gramophone companies. This makes the testing of L/P amplifiers a little difficult, but D. T. N. Williamson, of amplifier fame, has recently published in an article in our British contemporary, *Wireless World*, two circuits that completely obviate the need for frequency records, provided one has, or can borrow, an audio oscillator. These circuits consist simply of combinations of resistance and capacity which, when placed immediately after the output terminal of a constant-voltage audio oscillator, give an output which varies with frequency in exactly the same way as does that of a record, cut with the standard characteristic. Thus, in order to test a circuit, one of these equalizers is interposed between the oscillator and the circuit under test. Then, if the latter has the required response curve exactly to compensate for the response of the record, the over-all result will be a flat response. Needless to say, the circuits for 78 and L/P records are quite different. If you are about to build an audio oscillator, it would be a good plan to build these circuits into the instrument, and have them selectable, by means of a switch. Then the oscillator could be used as an ordinary constant-voltage device, or as a simulator for any of the three main types of record. Or, they could be built as a small unit, which can be attached to the output of the oscillator when needed. These circuits are so simple, and so obviously useful that it should not be necessary to say any more about them, except perhaps to point out that their input impedance is quite low, so that if the oscillator has a high output impedance, it will not be possible to connect them at the output terminal without spoiling the output of the oscillator, and probably its waveform too. However, should higher input impedances be needed, it is an easy matter to scale up the impedance of the networks. To increase their impedance by a factor of 10, all resistors should be made ten times larger, and all condensers a tenth as large. By multiplying the resistors, and dividing the condensers by any factor, the impedance can be raised by any desired value. The impedance of the 78 network is approximately 10,000 ohms at frequencies above 300 cycles per second, and higher than that below that frequency. The L/P network has an impedance of somewhat more than 10,000 ohms at 1,000 cycles per second, but the impedance gets progressively lower as the frequency is raised.

A good idea would be to precede the network with a cathode follower, whose low output impedance would not be affected by the input admittance of the networks.

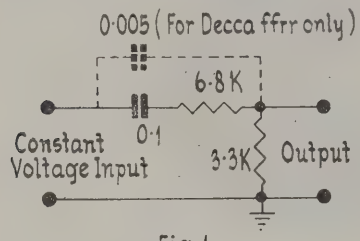


Fig. 1

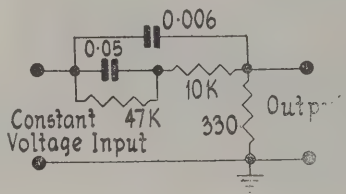
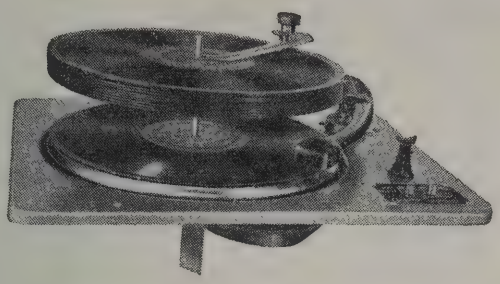
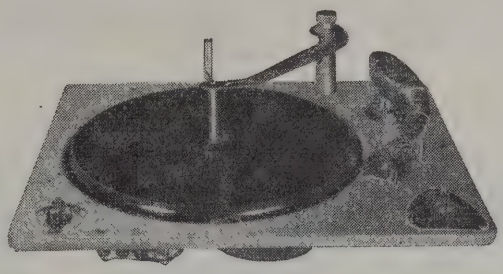


Fig. 2





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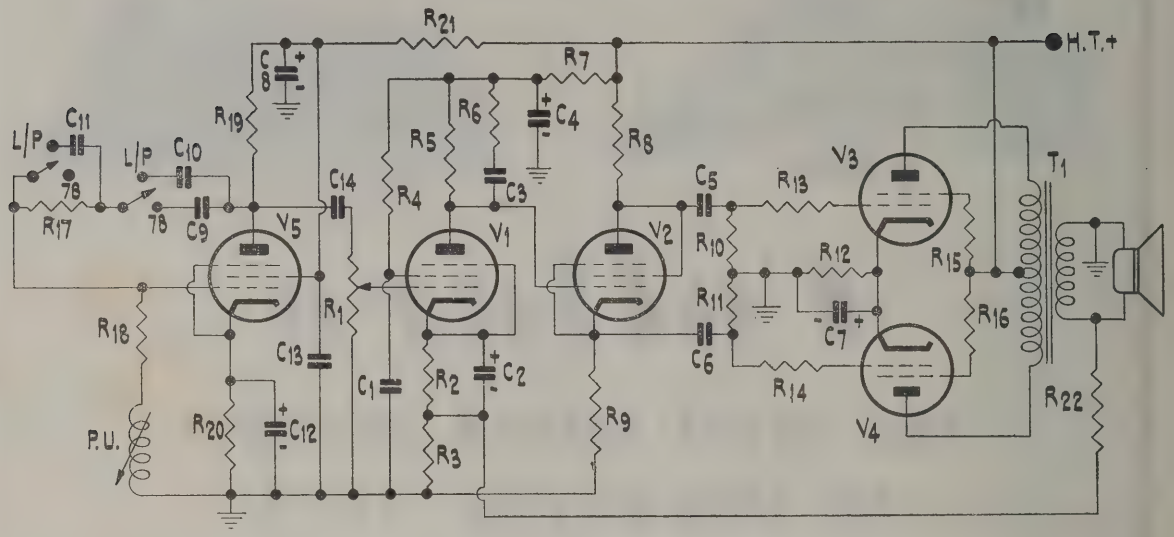


COMPONENT LIST

R_1, 500k. pot.
R_2, 2k.
R_3, R_{15}, R_{16}, 25 ohms.
R_4, R_{17}, 470k.
R_5, R_{10}, R_{11}, R_{19}, 220k.
R_6, 10k.
R_7, 40k.
R_8, R_9, 100k.
R_{12}, 250 ohms.
R_{13}, R_{14}, 1k.
R_{18}, R_{21}, 47k.
R_{20}, 1000 ohms.
R_{23} (omitted from diagram) 470k.
Note.—R_{23} is the screen dropping resistor for V_5.
R_{22}, feedback resistor, 400 ohms when speaker impedance is 15 ohms.
C_1, C_{13}, 0.25 μf.
C_2, C_7, C_{12}, 25 μf. 25v. electro.
C_3, 100 $\mu\mu$f.
C_4, C_8, 16 μf. 350v. electro.
C_5, C_6, C_{14}, 0.1 μf.
C_9, 0.001 μf.
C_{10}, 350 $\mu\mu$f.
C_{11}, 300 $\mu\mu$f.
V_1, V_2, V_5, 6AU6.
V_3, V_4, 6V6.
T_1, 10,000 ohms to voice-coil.

We have received so many requests for copies of our April, 1952, issue, which is, unfortunately, out of print, that we had to go to some trouble to find out just which article in that issue had created all the interest. As was suspected, the "78-L/P Special" was at the root of the business, so we are taking this opportunity of reprinting the circuit of that amplifier for the benefit of those who were unable to obtain a copy of the April issue.

The two main features of this amplifier are the built-in pick-up pre-amplifier, V_5, and the anti-oscillation circuit connected across the plate load resistor of V_1.

The feedback arrangement used with V_5 to give the necessary response compensation for either 78 or L/P records, according to the position of the switch, is probably one of the simplest, and yet most effective, ways of doing this yet to be published. However, since the original article was printed, we have decided that slight modification to the values of the condensers used in the L/P position of the switch will give rather better results.

CHANGES IN VALUES

The condensers concerned are C_{10} and C_{11}. The values shown in the main parts list give slightly too much bass boost, and a little too much top cut, too. It is recommended that they be changed so as to make C_{10} 500 $\mu\mu$f., and C_{11} 150 $\mu\mu$f. However, for those who are experimentally inclined, a little juggling with these values will do no harm, so as to get the response which sounds most pleasing. This is a good plan if the speaker used is not a particularly good one, or is not baffled as well as it might be. The values recommended above should be just right for a high-quality speaker in a well-constructed vented baffle.

AVOIDING HUM

In the original article, some notes were given on the avoidance of hum, since the overall amplification with this circuit is somewhat greater than many will be used to building into their amplifiers.

When building this circuit in its entirety, it should be remembered that the over-all gain is rather higher than that of ordinary amplifiers, used with high-output pick-ups. Consequently, a little more care than usual is necessary to ensure that the hum level is not excessive. For instance, on no account should a single wire be run for the heater circuit, with one side of each heater grounded. This causes large 50-cycle currents to flow in the chassis,

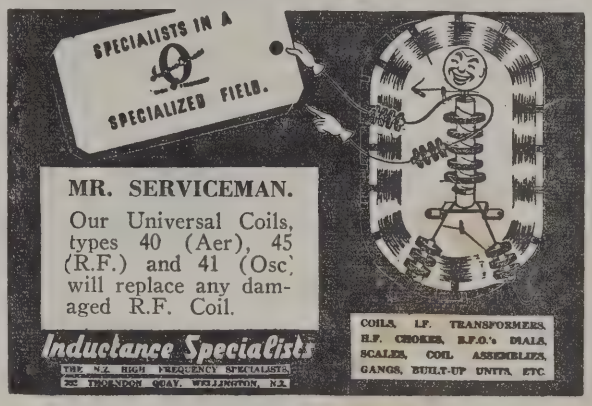
and is just asking for hum to be induced in the input circuit. Two wires should be run to every heater, and the heater circuit should be earthed at only one point. This point should be one of the heater pins of V_5. Also, the input socket, to which the pick-up leads are taken, should be as close as possible to the grid pin of V_5. Preferably, it should have two insulated connections instead of the more usual one, so that both pick-up leads are separately terminated. Then a wire is taken from one of them to the earth-point of the heater circuit. This prevents even the smallest piece of chassis from being part of the grid circuit of V_5, provided the cathode resistor and condenser of this valve are also earthed at the same spot. Of course, the pick-up leads should also be shielded with flexible braid, and this can be earthed by the external metal of the input plug in the ordinary way.

Should the hum still be found to be too great (but this is unlikely) the old trick should be tried of centre-tapping the heater circuit. If this is done with a potentiometer of 100 ohms or so, it should be mounted close to V_5, and the moving arm earthed at the same point as the pick-up lead and the cathode resistor and condenser of V_5. When the pot. is adjusted for minimum hum, the bit that is left should be less than when one side of the heater winding is earthed.

VALUE OF THE FEEDBACK RESISTOR

On the parts list, the feedback resistor R_{22} has been shown as 400 ohms, which is the correct value to use when the speaker has an impedance of 15 ohms. If the speaker has a different impedance, the correct value of

(Continued on Page 48.)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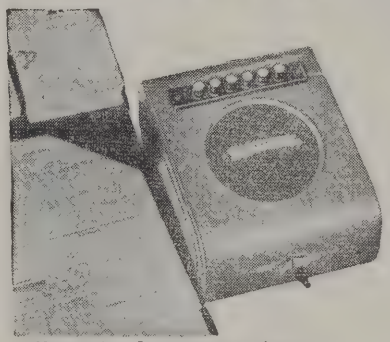

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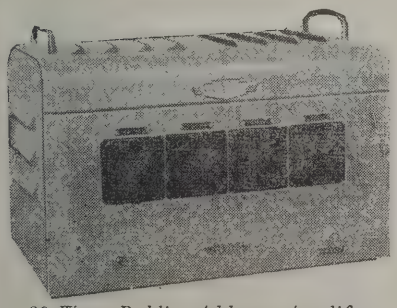

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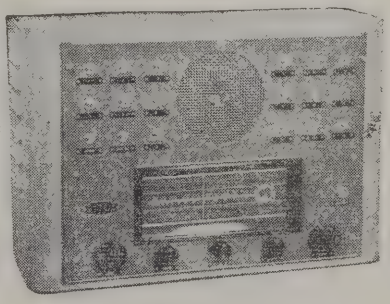

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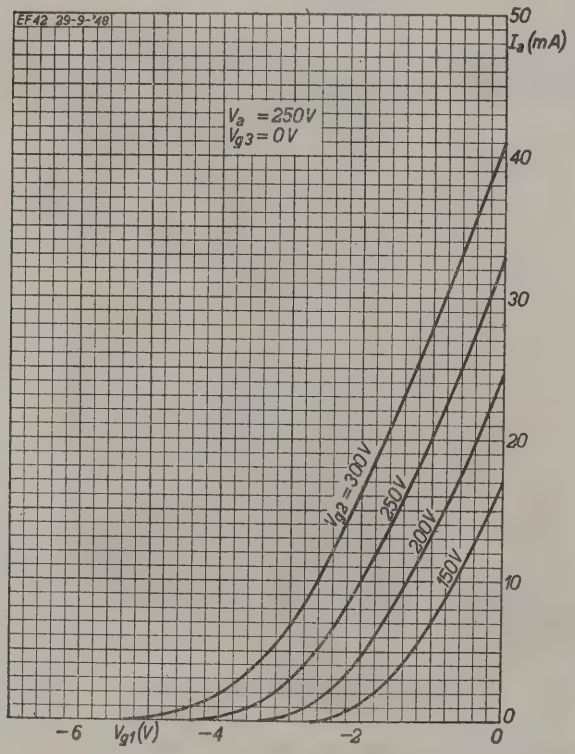
TUBE DATA: The EF42 High-Slope R.F. Pentode

impedances involved. The EF42, produced in Rimlock technique, is specially designed for such applications. This tube has a particularly high slope, viz., 9 mA/V., and a low capacitance between anode and control grid which greatly contribute to its usefulness for the above-mentioned purposes. When the tube is to be used as R.F. amplifier in receivers with high sensitivity a low figure for the equivalent noise resistance is required. With the EF42 this figure is only 840 ohms. In the frequency-changer section of an F.M. or television receiver the application of tubes intended for normal broadcast receivers meets with difficulties owing to the low conversion slope and high equivalent noise resistance. A special circuit has been developed in which the EF42 is used as self-oscillating frequency-changer, giving a conversion conductance of 2.5 mA/V and an equivalent noise resistance far below that of conventional frequency-changer tubes.

With high-slope tubes like the EF42 in some applications there is a risk of microphony, this, of course, depending to a large extent upon the position of the tube relative to the loudspeaker. When the tube is used as frequency changer vibrations of the chassis or of the air surrounding the tube may result in a modulation of the oscillator frequency. With I.F amplification and when the receiver is tuned at one of the flanks of the I.F. response curve vibrations will give rise to amplitude modulation of the I.F. output signal. A resilient tube holder should therefore be employed when the tube shows a tendency to oscillate at a frequency lower than 1,000 c/sec., whilst a damping envelope should be used when this frequency is higher than 1,000 c/sec, for example 3,000 c/sec.

A large number of other applications in special circuits, such as wide-band amplifiers in oscillographs

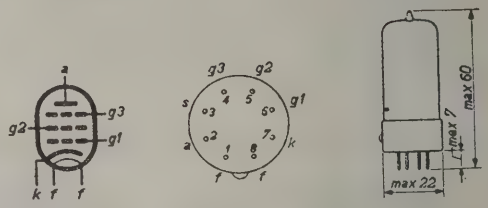


PENTODE for use as wide band amplifier

Heating: indirect by A.C.or D.C.; parallel supply

Vf = 6,3 V
If = 0,33 A

Dimensions in mm



Capacitances		
Ca	=	4,5 pF
Cg1	=	9,5 pF
Cag1	<	0,005 pF

Typical characteristics

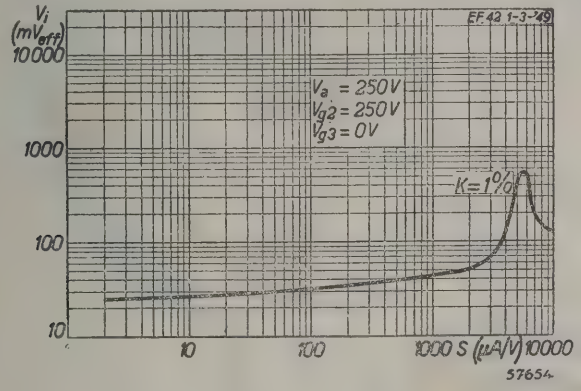
Va	=	250 V
Vg2	=	250 V
Vg1	=	-2 V
Ia	=	10 mA
Ig2	=	2,3 mA
S	=	9,5 mA/V
μg2g1	=	83 -
Ri	=	0,5 MΩ
Req	=	750 Ω

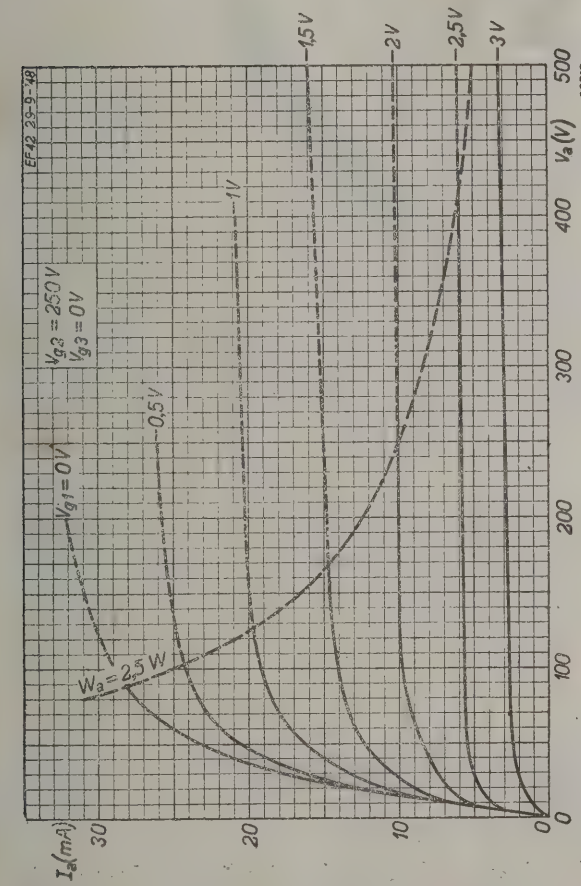
Limiting values

Va_o	= max.	550 V	
Va	= max.	300 V	
Wa	= max.	2,5 W	
$Vg2_o$	= max.	550 V	
Vg2	= max.	300 V	
Wg2	= max.	0,7 W	
Ik	= max.	15 mA	
Vg1 (Ig1=+0,3 μA)	= max.	-1,3 V	
Rg1	= max.	1 MΩ	
Vfk	= max.	50 V	
Rfk	= max.	20 kΩ	

and cathode followers, suggest themselves. The fact that each electrode is brought out to a separate pin and the inclusion of a metal shield around the electrode structure will prove to be an advantage when the tube is used in these circuits.

It is well known that in F.M. and television receivers high-slope pentodes are required in the I.F. and R.F. stages to obtain sufficient gain with the usually low load





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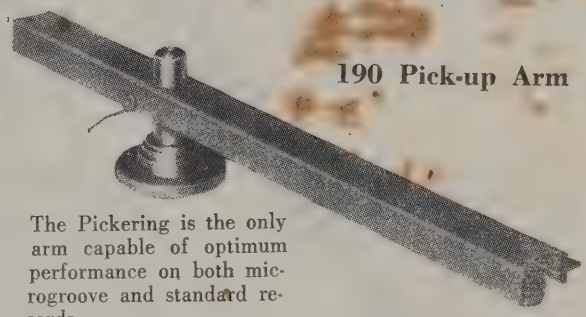

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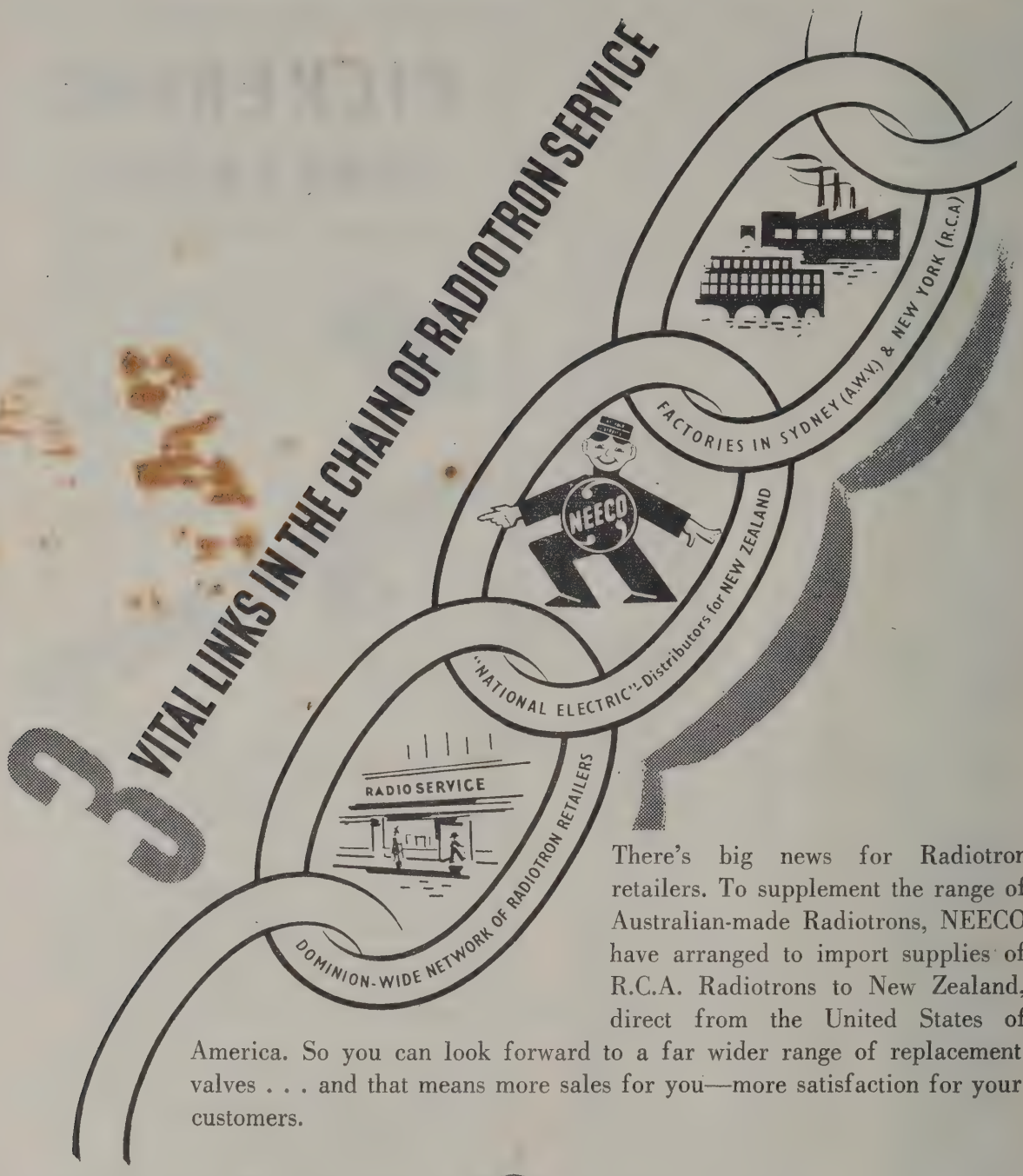
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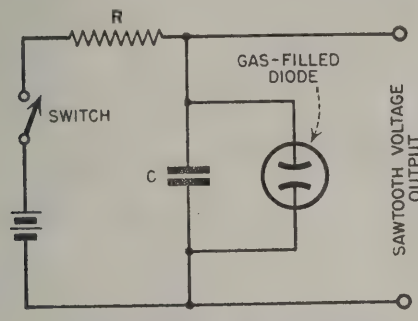
Non-Sinusoidal Wave Forms

Part II—Generators and Non-Linear Shapers

By the Engineering Department, Aerovox Corporation

In the preceding article, the response of four-terminal passive wave-shaping networks to various types of applied waveforms was discussed without regard to the actual generation of these waveforms. The present issue will be concerned with a description and discussion of several of the more basic methods of generating non-sinusoidal waves.



RELAXATION OSCILLATOR
FIG.1

Pulse generators as a general class fall into two rather loosely defined categories; the self-excited or self-sustaining generators such as the gas tube relaxation oscillator, the block oscillator, the multivibrator, etc., and the "driven" generators such as the squaring amplifiers, limiters and rectifiers. The self-excited generators require no input other than the usual D.C. operating potentials (plus a synchronizing or triggering signal if desired for improving stability), and are self sustaining as long as the D.C. power is applied. They operate on the rather simple principle that any system—electrical, acoustical, or mechanical—having two stable states of equilibrium may oscillate between these states if a sufficient amount of its output energy is fed back to the input in the correct phase. Thus, it will be readily seen that the escapement of a watch movement satisfies these conditions and is therefore a mechanical relaxation oscillator. The primary source of energy in this case is the potential energy stored in the spring.

Among the electronic pulse generators to be discussed is the familiar gas tube relaxation oscillator first used in the "dark ages" of electronics as an oscilloscope time-base generator. Briefly, the sequence of action in such a device, shown diagrammatically in Fig. 1, is as follows. After switch closure, condenser C charges exponentially through resistor R, the condenser voltage at any time being given by:

$$(1) \qquad e = E\left(1-\epsilon^{-\frac{t}{RC}}\right)$$

Where:

- e is the instantaneous condenser voltage
- E is the battery voltage
- ϵ is the base of Naperian logarithms
- t is the time in seconds after switch closure
- R is the resistance in ohms
- C is the capacitance in μfds

If the gas tube were not in the circuit, the condenser voltage would in time be equal to the full battery voltage. However, when a gas diode having an "ignition" potential somewhat lower than the battery voltage is connected as shown in Fig. 1, the condenser voltage at some point on the charging curve will be sufficient to ionize the gas, rendering it conductive. In this condition the tube serves as a discharge path for the charge stored on the condenser. The condenser voltage will decay exponentially toward zero until it reaches the "extinction" voltage of the gas tube permitting deionization to take place, whereupon the condenser voltage again charges toward the ignition potential and the cycle repeats. The output voltage for large values of the RC time constant is the distorted sawtooth shown as the solid line of Fig. 2. Also shown (dotted lines) is the output voltage for identical battery voltage and gas tube conditions but with a small time constant (RC). With this simple relaxation generator, the output must be limited to about 5 or 10 per cent. of the supply voltage if a linear sawtooth is desired.

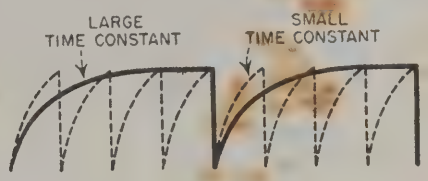
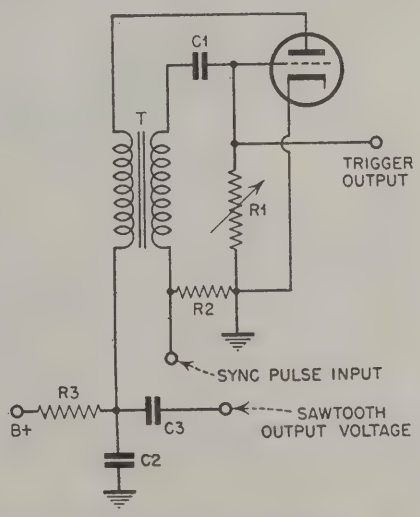


FIG.2



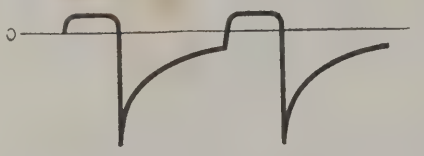
BLOCKING OSCILLATOR
FIG. 3

As a refinement, the gas diode of Fig. 1 may be replaced by a gas-filled triode, or *thyratron*, and the

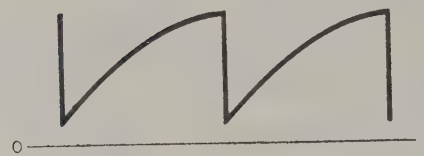
charging resistor by a constant current source such as the plate resistance of a pentode.[2] With these modifications, a much larger portion of the supply voltage appears as linear sawtooth at the output of the generator. In addition, it is relatively easy to inject a synchronizing pulse into the grid circuit to insure that the sawtooth generator will "lock in" synchronously with some desired repetition frequency.

A pulse of very short duration may be obtained from the gas tube type of generator by inserting a resistor into the cathode circuit of the thyratron. The voltage pulse across this resistor is, of course, proportional to the discharge current pulse of the condenser, and may be made of short duration by the proper choice of tube and circuit parameters.

The blocking oscillator,[3] Fig. 3, has been widely used in television receivers as a pulse generator for accurately timing the sweep generator. Here again the *modus operandi* is the relaxation principle, with an iron core transformer serving as the feedback coupling mechanism. The transformer must of necessity be so phased that an increase in plate current causes an increase in grid voltage in the positive direction, and vice versa. Under these conditions the slightest fluctuation of plate current is sufficient to drive the tube either to cutoff or plate-



(a)
GRID VOLTAGE OUTPUT



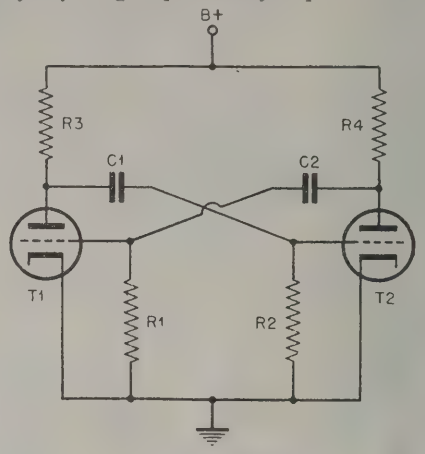
(b)
PLATE VOLTAGE OUTPUT

BLOCKING OSCILLATOR WAVEFORMS
FIG. 4

saturation, depending on the polarity of the initial disturbance. For a positive-going disturbance, the plate current will increase until the rate of rise of plate current decreases sufficiently to make the rate of change of net grid voltage negative, at which time the plate current falls to zero. During the fall of plate current, as well as during the rise, the transformer phasing dictates that the rate of change of current shall be extremely rapid. Since the grid draws appreciable current during a portion of the cycle, once the plate current has fallen to zero, it will remain cut off until the accumulated negative charge on the grid condenser (and consequently the net grid voltage) becomes sufficiently small to again permit the flow of plate current. As may be seen, the cycle is repetitive and self-sustaining.

Fig. 4 depicts typical grid and plate voltage waveforms observed in blocking oscillators. The grid voltage may be used as the trigger pulse to fire a discharge-tube type of television sweep generator which will be discussed later, or the plate output may be used directly as the shaped sweep waveform. Both methods have been used satisfactorily in commercial television receivers.

Synchronization of a blocking oscillator may be accomplished by injecting a positive sync pulse into the grid



MULTIVIBRATOR
FIG. 5

circuit as shown in Fig. 3. For best results, the free-running frequency of the blocking oscillator (controlled by R_1 of the above figure) should be slightly lower than the frequency of the sync pulses, although synchronization with multiples or sub-multiples is possible.

Several modifications of the free-running blocking oscillator should also be mentioned. For example, if sufficient negative bias is applied to the grid, self-sustained oscillations may be prevented. This circuit, called a "driven blocking oscillator," will oscillate for only one cycle each time a trigger pulse is applied. Another useful variation is the "positive grid blocking oscillator," in which the grid is operated with a slight positive bias to reduce random pulse-to-pulse time "jitter."

Closely related to the ordinary blocking oscillator is the generator first referred to in British literature as the "squegging" oscillator. In this circuit, the feedback mechanism is an R.F. transformer. The action of this type is similar to that of the blocking oscillator, with the significant exception that, instead of the single burst of plate current normally occurring in the blocking oscillator, there may be several cycles of R.F. oscillations generated before sufficient charge accumulates on the grid condenser to cut the tube off. This action, incidentally, is identical with that occurring in super-regenerative detectors. Squegging oscillators have been tried as rather primitive radar transmitters, but the synchronization problems involved have precluded their wide usage.

Another circuit which may be used as a non-sinusoidal wave generator is the multivibrator.[4] In its simplest form (Fig. 5), this may be thought of as a two-stage, resistance-coupled amplifier whose output and input are regeneratively coupled. The circuit operation may be readily understood by recognizing that two stable states are possible; tube No. 1 conducting when tube No. 2 is cut off, and vice versa. The tube that is cut off will remain in that condition until the negative voltage charge accumulated on its grid condenser during the grid conduction period has decayed sufficiently to permit plate current to flow. The light feedback coupling makes the build-up of current extremely rapid. When this occurs, the phasing is so arranged that the other tube will be cut off, and the cycle repeats. Like the blocking oscillator,

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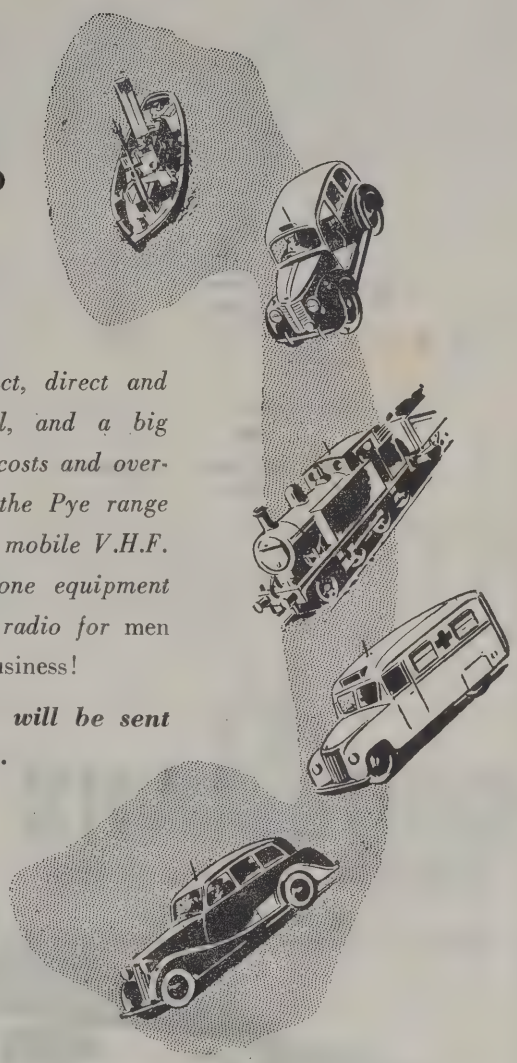

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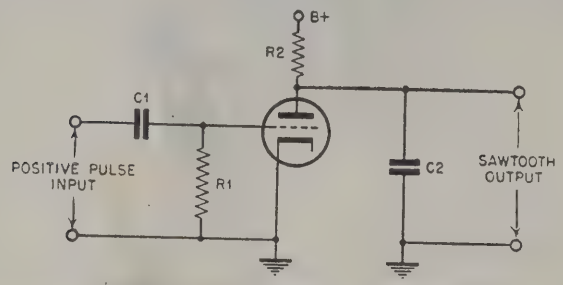
the multivibrator may be synchronized by injecting a sync pulse into either grid circuit.

As mentioned above for the blocking oscillator, the free-running multivibrator may be altered in several ways from varying applications. If, for example, the circuit is arranged so that one tube is permanently biased to cutoff, and a positive trigger pulse is applied to its grid, the circuit will complete only one cycle of multivibrator action and return to the most stable state—that of the permanently biased cutoff condition. This type



DISCHARGE-TUBE SWEEP GENERATOR
FIG. 6

of multivibrator, called a Kipp relay, may be further modified by removing the condensers and providing conductive feedback paths. With this circuit, the tube that is cut off will remain in that condition until triggered by a positive pulse. The circuit will flip to the other equilibrium condition with the other tube cut off, and will remain that way until it too is triggered similarly. The shift occurs only once for each triggering impulse applied.

The output of a symmetrical multivibrator will be the square wave illustrated in Fig. 1b of Part I. The term "symmetrical" implies that the values of resistance and capacitance in the grid and plate circuits of one of the tubes are equal, part for part, to those of the other tube. For this circuit, the frequency of oscillation is given by:

(2)

$$F = \frac{1}{2RC}$$

Where:

F = frequency in cycles per second.
R = resistance of the grid resistor in ohms.
C = capacitance of the coupling condenser in ohms.

A convenient method of varying the frequency is by using a dual potentiometer as the grid resistors.

In the unsymmetrical multivibrator, i.e., one in which *unequal* values of grid resistors and coupling condensers are employed, the output waveforms will resemble Fig. 1g of the previous article.

The sawtooth sweep generator referred to as the "discharge tube" in commercial television practice is a simple circuit (Fig. 6) whose operation is quite similar to that of the gas tube relaxation oscillator discussed above. Here, however, the discharge occurs when the grid potential is made positive enough to reduce the plate

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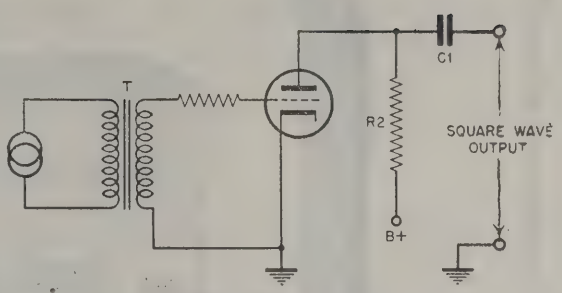
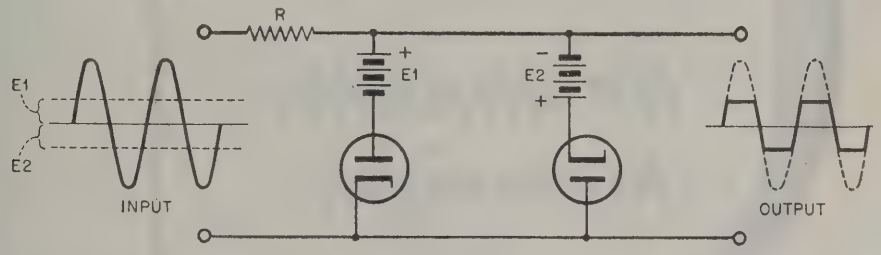
resistance of the tube to a small value. Between pulses, of course, the voltage across the storage condenser rises more or less linearly and, if limited to about 5 per cent. of the supply voltage, may be used as a sweep voltage waveform of a television receiver.

In conclusion, a brief description of typical *driven* waveform generators, such as the overdriven amplifier and the limiting diode circuits, will be given. The overdriven amplifier (Fig. 7) consists of a conventional amplifier tube and associated circuit which is operated in such a manner that both plate and grid limiting occur. If a large sinusoidal voltage is applied to the input, the tube is driven beyond cutoff during most of the negative excursion of the sine wave. During the positive portion, however, the grid will draw current, which is limited by the series grid resistor. Under these conditions,

(Continued on Page 48.)



OVERDRIVEN AMPLIFIER
FIG. 7



DIODE CLIPPER
FIG. 8

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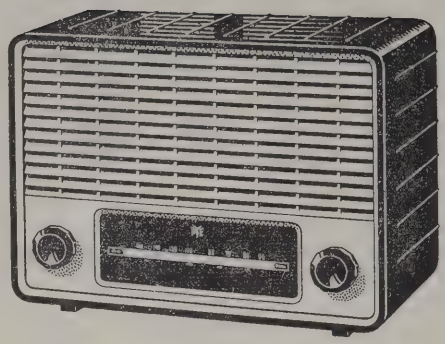

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NOISE SUPPRESSION

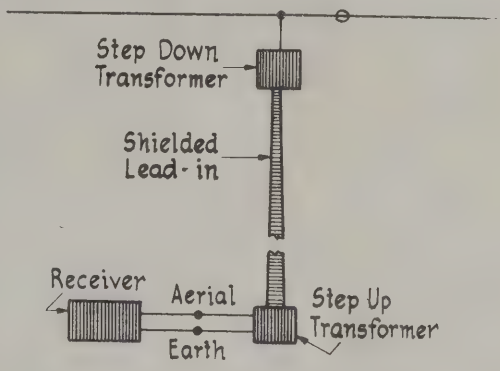
The installation of a radio receiver in an industrial area or big city where high electrical noise levels prevail has proved a stumbling block to more than one radioman. Where the customer particularly requires reception from stations other than just "locals" the problem becomes extremely difficult. One solution, of course, is for the radio serviceman to avoid people who look like bookmakers, who want advance race results from round the country. However, that is not a complete answer to the question.

Noise emanating from electrical disturbances fortunately falls off in intensity very rapidly as the distance increases from its source of origin unless it is carried about by lines such as power cables or tramway overhead cables. In a large city, with its multiplicity of electrical gadgets in every shop and office, the noise intensity at or near ground levels is likely to be very high. The alternative, then, is to mount the aerial as high as possible and orientate it away from possible noise sources.

The next problem is then how to get the lead-in down (most probably through several floors of a building) without picking up all the noise again. This can be done by shielding the lead-in, but before this is possible it is necessary to overcome the losses which would be incurred by using a long length of shielded cable. The method adopted in practice is to feed the aerial directly into a step-down transformer mounted right up on the aerial itself, the shielded cable then connects from the low-impedance secondary winding of the transformer to a similar transformer mounted near the receiver. This lower transformer steps the impedance back up to a high value once more for the purpose of feeding the set. Although some losses are incurred in the transformers themselves, they are small enough to be unimportant when compared with the very considerable gain obtained by using a shielded lead-in. It should be emphasized, however, in order to clear up a popular misconpception about these systems that they do not magically filter out noise from the aerial itself. That is impossible. All they do is render the lead-in much less susceptible to noise pick up than the conventional type.

Frequently a vertical whip type aerial will prove more successful than the usual horizontal type. The reason is that most forms of electrostatic and electromagnetic noise waves are of a horizontally polarized nature and aerials mounted at right angles to their polarization will be least susceptible to them. Also, it is generally more convenient to mount a whip type aerial higher up on a building than it is an inverted L-type wire.

Noise coming in through the mains is generally too difficult to overcome easily, for although it is possible to fit a line filter, the wiring through the house or building is radiating so strongly that its action is largely voided. If the set could be operated in a screened room, the power line filter would then be of very real value. All electrical appliances in the immediate vicinity of the set should be vetted for possible noise generation. Brush discharges from commutator type motors can generally be cured by taking a condenser from either brush to the frame of the motor which should be earthed in a satisfactory manner. Fluorescent lights are one of the most prolific sources of noise and one of the biggest headaches to overcome. These lights should have filters on them in the first case to prevent noise getting back through the mains, but this, of course, does not prevent the light from radiating on its own account. Where possible, a wire netting shield surrounding the entire light



fixture and properly earthed is the best arrangement, but this is generally too unsightly to put into most places. There appears to be little that can be done about this trouble, although a good aerial mounted well away from the fluorescent lights and fed to the set by way of a transformer-coupled shielded lead-in, as explained previously, may prove helpful. The chances are, however, that the noise will be induced into the set wiring itself generally, owing to the close proximity of the receiver to these lights. A good aerial through will generally guarantee a signal sufficiently strong to override the noise on stations of reasonable strength, and this would seem to be about the best that could be made of a bad job.

Car ignition interference is another trouble about which little can be done. Of course if the motorist is fitted with a car radio it is in his own interests to see that his ignition is properly suppressed and consequently he doesn't interfere with the radio reception of other people. Fortunately, however, cars still run on the ground, so an aerial mounted several floors up on a building should help to obviate or lessen this form of interference. At this juncture the witty are asked to refrain from cracks about aircraft—if it's a decent plane it should have a shielded ignition system.

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No. 58: Super-Selectivity Without Tears—Part II

Part I of this article described the principle of the super-selective I.F. stage, using a cathode follower with controlled positive feedback to the tuned grid circuit. This month, we go on to describe the circuit and construction of an actual I.F. channel, constructed round the super-selective stage as a basis. In Part III, to appear next month, we round off the picture with a discussion of some types of audio selectivity that can be obtained without too much difficulty, and which can be incorporated with the present circuit if desired.

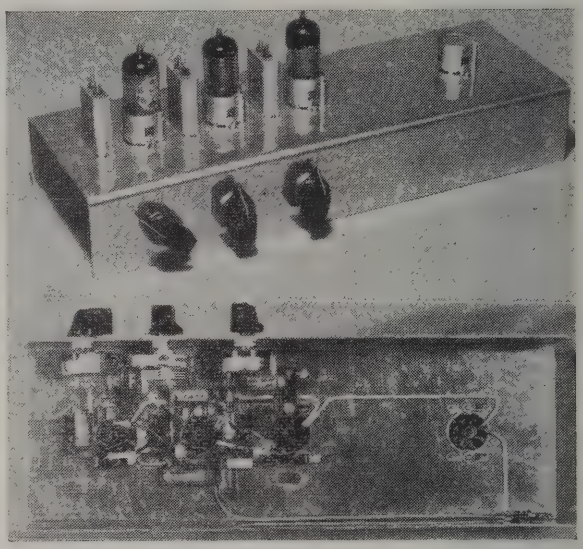
CIRCUIT OF THE I.F. AMPLIFIER

Although the super-selectivity stage can be made to work at almost any frequency, the almost standard 455 kc/sec. was chosen, as having the greatest possible breadth of application. In order to make a compact unit, Philips Rimlock valves have been used, together with the latest Philips midget I.F. transformers. As can be seen from the photographs, the flat construction of these transformers makes it possible to space the valves as closely on the chassis as is convenient for wiring up, and the whole I.F. strip is uncrowded, without taking up very much space.

The circuit starts off with one I.F. transformer, whose primary winding connects to the plate circuit of the mixer valve which terminates the tuner. Then comes the super-selective stage, which uses a Philips EF42, and a modified I.F. transformer of the same type as the other two used in the unit. The output of the EF42 taken from the cathode pin, is capacity-coupled to the grid of the Philips EF41, which is a conventional I.F. amplifier stage, feeding a Philips EB41 as detector and A.V.C. rectifier.

The EF42 has its plate, suppressor, and screen all tied together at the valve socket, and by-passed to earth by a 0.01 μf. condenser. A 3k. decoupling resistor is in series with the three elements, which act as the plate of a triode. There is no advantage to be gained by working the valve as a pentode, which entails the use of additional components. Since the Q of the grid circuit of the EF42 is raised to exceedingly high values, it is essential that coupling to the preceding tuned circuit should be very loose indeed. If the coupling is not loose enough, the coupling between the windings may become greater than critical, especially when the selectivity control is at or near maximum, and should this happen, proper alignment of the circuits will become impossible. Accordingly, the "hot" end of the initial transformer secondary is connected to the EF42's grid circuit through a 250k. resistor in series with a .100 $\mu\mu$f. condenser. Either of these components can be varied to change the coupling, reduction of coupling being obtained by reducing the size of the condenser or increasing the size of the resistor.

The condensers connected in series to tune L_1 are 200 $\mu\mu$f. each, making the effective tuning capacity 100 $\mu\mu$f., so that the winding of L_1 can be identical with the individual windings of the other I.F. transformers. The prototype used Philips I.F. transformers, but this is not essential. Any good I.F. transformers can be used, and irrespective of the type, one can be modified for use as L_2. The small condenser C_3 is brought out to the front panel, and is a fine tuning control, which will be found very useful in actual operation of the unit. It enables the exact position of the very sharp response of the EF42 circuit to be moved about inside the far wider pass band of the remaining two transformers, and thus facilitates the accurate tuning of a signal when the higher grades of selectivity are being used. Shifting C_3 gives a much finer and more practical control than the main tuning dial, which can really be used only when the selectivity is in the "wide" position.



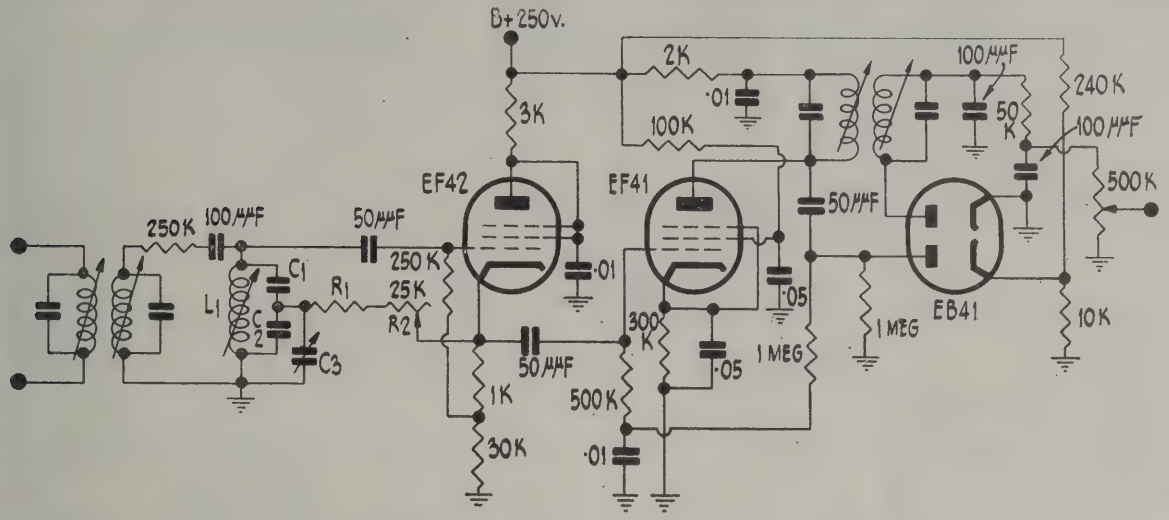
Above: Top-chassis view of the unit whose circuit is given on the next page. Space has been left for a B.F.O., an audio filter, and an A.F. amplifier valve. The completed unit will be shown in Part III of this article.

Below: Under-chassis view. The controls, left to right are: Selectivity, fine frequency, and A.F. output.

The circuit of the remaining two valves is quite ordinary, and requires little comment. The A.V.C. diode is fed from the primary of the last I.F. transformer, giving a somewhat greater control voltage than can be obtained from the secondary. With 10 volts delay applied as a positive bias to the cathode of the A.V.C. diode, weak-signal performance is not impaired, and the output level on 'phone is held remarkably constant for all signals which exceed the A.V.C. threshold value.

It should not be forgotten that when selectivity of a very high order is available, as here, it is not necessary

to remove the A.V.C. for C.W. reception, as long as the A.V.C. voltage is picked off at a spot in the circuit which follows the super-selective device, otherwise it is possible for a strong signal to be inaudible because of the high selectivity, and yet to work the A.V.C., so that the gain of the receiver is controlled not by the signal that is being copied, but by the strong signal which is not otherwise creating interference. There seems to be a fairly widespread prejudice against using A.V.C. on C.W. reception, but this seems to be largely due to the failure of receiver manufacturers to incorporate arrangements which enable A.V.C. to be successfully used when the B.F.O. is in operation. There are only two requirements to be met. The first of these is that the B.F.O. shall not (repeat NOT) operate the A.V.C. diode. This can easily be ensured by using a suitable diode detector and A.V.C. diode circuit, of which the one shown here is an example. The delay of ten volts on the A.V.C. diode ensures that a B.F.O. signal of this magnitude must be induced into the primary of the last I.F. transformer before it can affect the A.V.C. circuit in the absence of a signal. As long as this condition is met, the turning on of the B.F.O. will not reduce the sensitivity of the receiver by operating the A.V.C. rectifier, and biasing back the valves. The second requirement is for a long time-constant in the A.V.C. circuit, to prevent the annoying "breathing" effect that occurs if the sensitivity of the receiver is able to come back to maximum between characters or words. It is a very simple matter to increase the A.V.C. time-constant to any desired extent simply by shunting a large condenser across the main A.V.C. filter condenser. The latter is usually made smaller in communications receivers than in ordinary broadcast sets, so that the A.V.C. can make some attempt to cope with flutter-fading, but if a condenser of 0.5 μf. or even larger is connected in parallel with the 0.01 μf. A.V.C. filter condenser, the A.V.C. voltage will remain on the valves for about four seconds after the signal producing it disappears. This allows the transmitting operator plenty of time to think what he is going to say next, without the receiver turning itself "flat out" between the end of one sentence and the beginning of the next. Indeed, it is a very simple matter to have a number of condensers, selectable by a switch, so that the time-constant can be chosen to suit the speed of the transmission. Other things being equal, it is preferable to work with as short a time-constant as possible, since a very long one makes tuning difficult sometimes. However, a switch giving a choice of two time-constants is quite satisfactory, since the normal short one can be using for tuning purposes, and the long one switched in when final adjustments have been made.



CONSTRUCTION

For the laboratory model of the I.F. channel, a simple U-shaped chassis was employed, as shown in the photographs, but there is no reason why exactly the same layout cannot be used as portion of a complete receiver. The input transformer is nearest the left-hand end of the chassis, and this is followed by the EF42 and then its input circuit. These are followed by the EF41, the last I.F. transformer, and the EB41. The space left on the chassis is to accommodate a B.F.O. circuit, an audio filter, and an audio valve, to complete the line-up, and which will be the subject of the next Experimenter. The arrangement of the EF42 and its tuned circuit is unusual, in that the layout does not follow the circuit's progression, as is usually the case. The way shown does make the wiring a little more compact, but there is no reason why readers should not place the input circuit to the left of the EF42 should they wish. Simple point-to-point wiring is used throughout, only the ordinary precautions being taken, of putting all by-pass condensers as close as possible to the points which they are to by-pass, and of earthing the central spigots of the Rimlock sockets. The compact layout ensures that all leads carrying R.F. are short, so that if the sockets are oriented so that the grid pins face the input side of the circuit, and the plate pins the output side, there should be no possibility of instability through radiation from the wiring. It should be emphasized, though, that the grid circuit of the EF42 is a vulnerable spot as far as feedback is concerned, because of the exceedingly high impedance which exists there, especially when the selectivity control is advanced. Accordingly, special pains should be taken in this part of the circuit to see that the term "point-to-point" describes the wiring in fact as well as in name. It is perhaps surprising that no special shielding was found necessary in the whole unit, but we are satisfied that this is not simply a fluke. It is probable, however, that if larger I.F. transformer were used, that did not lend themselves to such a compact layout of parts.

(Continued on Page 33.)

The "RADIO and ELECTRONICS" Abstract Service

ANTENNAE AND TRANSMISSION LINES

Stacking 4 Z-matched yagis; a practical system of stacking the yagis by extending the principle of impedance matching which led to the system. The resultant gain of over 14 db. is the highest yet attained in a practical television antenna.

—*Radio and Television News* (U.S.A.), April, 1952, p. 57.

Certain radar applications require a means for rapidly scanning a beam over a volume in space. A feed horn is used and an array of "pipes" the energy being fed to the "pipes" by rotary movement. This avoids physical movement of the whole apparatus and gives rapid scanning of the sector.

—*Electronics* (U.S.A.), May, 1952, p. 126.

AUDIO EQUIPMENT AND DESIGN

A study of acoustical improvements for a hall at Maida Vale. The opinion was formed that the best tone was obtained in those halls with a rectangular form of ornamentation. For "boominess" a membrane absorber was used—a cavity sealed by a flexible membrane of bituminous roofing material. Charts of reverberation time are given to illustrate the principles.

—*Wireless World* (Eng.), April, 1952, p. 128.

By their very nature original tape recordings cannot be processed as discs. By one process the virgin tape and the recorded are rolled in close contact through a magnetic field, but the result is not entirely a facsimile. Another method is to record a large number at a time from the master roll, but this, too, has difficulties. A new recorder has been developed which will reproduce with high fidelity.

—*Radio and Television News* (U.S.A.), April, 1952, p. 40.

Audio simplified. This article deals with the advantages of the push-pull output stage and the reasons. The curves for construction are given and a modified schematic of the Williamson amplifier. The qualities of loudspeakers are also discussed.

—*Ibid*, p. 74.

CIRCUITS AND CIRCUIT ELEMENTS

In nuclear research pulses of as small as one ten thousandth of a microsecond are sometimes required. The paper discusses the properties and applications of the various circuit elements with particular reference to secondary emission pentodes. These valves give the very wide bandwidth required for the pulses.

—*Electronic Engineering* (Eng.), May 1952, p. 214.

The article explains how vacuum tubes can be used as variable resistance circuit elements; also expander and compressor circuitry.

—*Radio and Television News* (U.S.A.), April, 1952, p. 72.

More information on the magnetic amplifier. Where stability and low frequency are required the amplifier has many uses.

—*Electronics* (U.S.A.), May, 1952, p. 132.

How to design R.F. coupling circuits. This has been more of an art than a science in the past. The article is a collection of engineering design information and provides a practical means of designing and adjusting circuits. A very useful article indeed.

—*Electronics* (U.S.A.), May, 1952, p. 134.

A treatise on R.C. oscillators; calculations of the oscillator frequency, calibration of the dial; phase shift; necessity for amplitude limitation; the power amplifier; push-pull output and internal voltmeter.

Philips Application Bulletin (Holland), Vol. 12, No. 6/7.

A.G.C. by means of miniature negative temperature coefficient resistors with a heating element. The control current flows through the heating element, thereby increasing the temperature and reducing the resistance of the resistor. This may be connected to an amplifier the input voltage of which is controlled by the resistor.

—*Ibid*, Vol, 12, No. 2, p. 33.

An electric time delay circuit described. The resistance-capacity type is that usually adopted for the control of apparatus such as photographic timers, etc. The method of construction and necessary mathematics are given.

—*Ibid*, p. 38.

The conditions are described which produce the microphonic howl in the capacity microphone. The phenomenon and its cures are discussed.

—*Ibid*, Vol. 12, No. 4, p. 76.

ELECTRONIC DEVICES

There is a relation between the working of the brain and muscle and the servo mechanism. Nature uses negative feedback loops in the circuitry of the nervous system. The article contains a number of interesting analogues of nerves and electrical systems especially in relation to the alpha rhythm of the brain which seems to serve as a scanning system.

—*Wireless World* (Eng.), April, 1952, p. 137.

MATHEMATICS

The prediction of audio-frequency response—the single complex impedance of resistive networks. The charts give the response of circuits including an iron-cored component, eddy current loss, and the computation of the loss in amplitude and phase.

—*Electronic Engineering* (Eng.), May, 1952, p. 241.

MEASURING INSTRUMENTS AND TEST GEAR

Valve testers are those which (a) give a meter indication of gm; (b) by elaborate equipment give a display of Ia—Va characteristics on a C.R.T. The instrument described will give fair information without great expense. The valve characteristics are traced during alternate positive going anode sweeps on the screen.

—*Electronic Engineering* (Eng.), May 1952, p. 220.

A versatile phase-angle meter. The C.R.T. may be used by connecting one voltage to the Y deflecting plates and the other to the X, when an ellipse is formed. The instrument adapts this principle by the use of a circular trace, the other voltage being connected to a pulse amplifier to extinguish the trace at a certain spot.

—*Ibid*, p. 224.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

Cold cathode glow discharge tubes; basic trigger tube circuits on the flip-flop principle; binary and decimal counting trains; multi-cathode tube counters wherein a gap on firing influences the following gap by lowering its break-down potential; also the application of the tube to counting devices.

—*Ibid*, p. 250.

Details of the Bell Laboratories new junction transistor. Hard work in the laboratories have made the device the first serious rival of the vacuum tube. The device is about half the size of a pea, power amplification as high as 50 db., and almost indefinite life.

—*Radio and Television News* (U.S.A.), April, 1952, p. 38.

Klystron oscillators are the most commonly used for commercial V.H.F. equipment. They are called "transit time oscillators" because the energy required to sustain oscillation is obtained from the electron stream. The principle of producing the oscillations is described and the practical aspects of the tubes.

—*Ibid*, p. 54.

PROPAGATION

A great deal of interest has been aroused by the abnormal behaviour at times of sporadic E clouds. Tests indicated that the clouds are the source of noise radiation similar to solar radiation and may be due to upper weather conditions and solar radiation.

—*Wireless World* (Eng.), April, 1952, p. 136.

TELEVISION

The good radio technician can shoot trouble by using his ears, and a television man uses his eyes. The article gives sample pictures of test patterns each of which shows a typical fault and gives a clue to the cure.

—*Radio and Television News* (U.S.A.), April, 1952, p. 37.

Experience indicates that the noise rejection circuits of modern TV receivers are often neglected. These take advantage of the fact that sync pulses are regular while noise pulses are not. The methods of servicing these circuits are given.

—*Ibid*, p. 60.

Crispening and resolution improvement in TV receivers; where in elements of a picture there is a sudden transition from black to white there is a degeneration of the pulse. The differentiators of the circuit emphasize the high frequency portions of the signal.

—*Radio and Television News* (U.S.A.), April, 1952, p. 106.

Phase linearity with phase shift proportional to frequency produces a picture most faithful to the original. Production receivers can be designed with narrow bandwidth and linear phase-shift for pictures without smear. The narrow bandwidth facilitates this construction and more than offsets the greater detail of the wide band system.

—*Electronics* (U.S.A.), May, 1952, p. 103.

TRANSMITTERS AND TRANSMITTING

A novel 1400 mc/sec. radio telephone is described. The difficulty of keeping a V.H.F. oscillator stable in the transmitter and the receiver is overcome by a master and slave principle. The oscillator at the slave terminal is controlled by signals from the master station. Two signals are radiated to keep the stations in accord with resultant simplicity of equipment.

—*Wireless World* (Eng.), April, 1952, p. 132.

A new horizon in amateur radio is opening with the advent of practical side-band transmission. The phasing system makes use of the principle of balancing out unwanted components by generating others equal in amplitude but opposite in phase. A description is given of an adapter to give the result required which is used between the exciter and an 150-watt R.F. amplifier.

—*Radio and Television News* (U.S.A.), April, 1952, p. 43.

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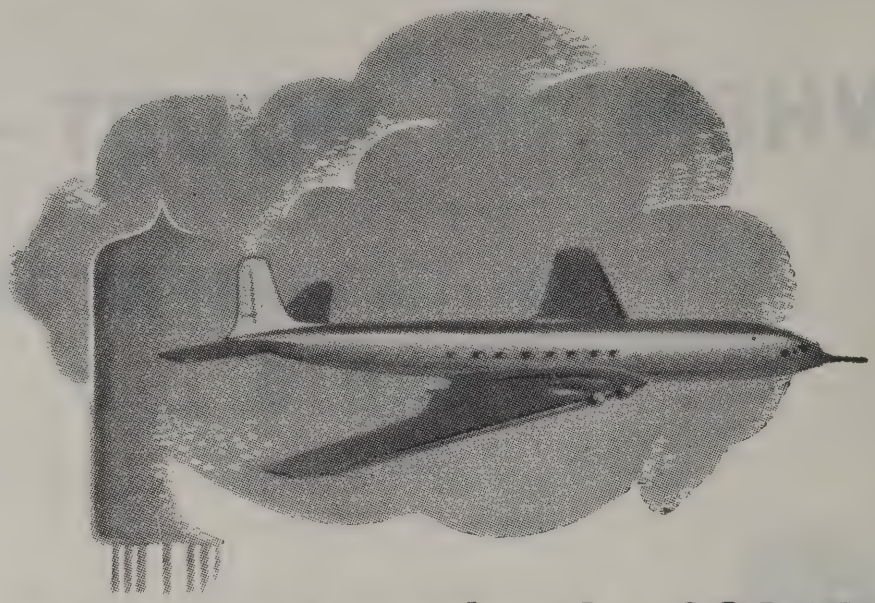

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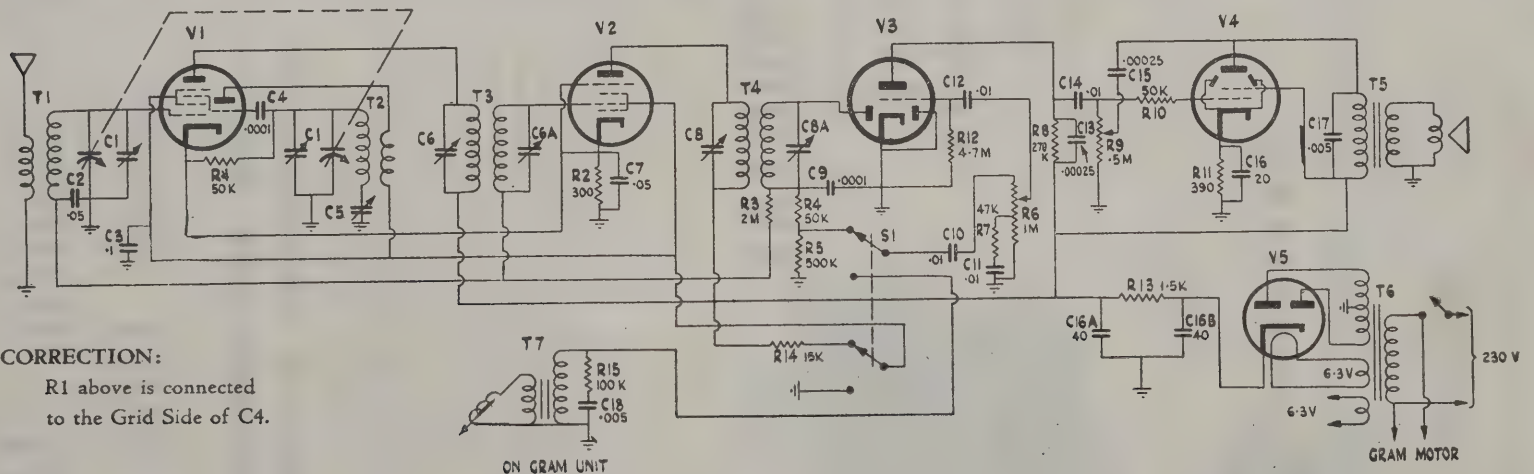


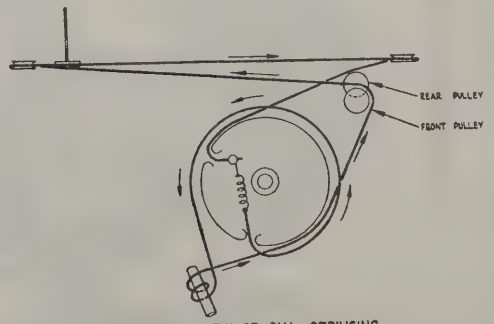
CORRECTION:

R1 above is connected to the Grid Side of C4.

ON GRAM UNIT

PARTS LIST

C1	POLAR 2 GANG	R1	50 K ½ W	S1	WAFER TYPE GRAM RADIO SWITCH
C2	·05 MF 750 V. TCC TYPE 363	R2	300 Ω 1 W CARBON	T1	AERIAL COIL AS 3316 A
C3	1 MF 500 V. RJ	R3	2 M Ω ½ W	T2	OSCILLATOR COIL OS 343
C4	0001 MF TCC MICA	R4	50 K ½ W	T3	1ST IF TRANSFORMER TS 22B/9
C5	PADDER MMFD TYRO	R5	500 K ½ W	T4	SECOND IF TRANSFORMER TS 22B/9
C6	DUAL IF TRIMMER BASE	R6	1 M Ω TAPPED POT	T5	SPEAKER TRANSFORMER 5000 Ω - VC
C7	·05 MF 350 V TCC TYPE 346	R7	47 K ½ W	T6	60 MA POWER TRANSFORMER
C8	DUAL IF TRIMMER BASE	R8	270 K ½ W	T7	PICK UP TRANSFORMER
C9	0001 MF TCC MICA	R9	500 K HOT WIRE SWITCH		SPEAKER 6Ω ø 6W
C10	·01 MF 500 V QR	R10	50 K ½ W		GRAM MOTOR & PICK UP
C11	·01 MF 350 V QR	R11	390 Ω 1 W +LT 400 Ω 1 W		MWB SINGLE PLAYER
C12	·01 MF 350 V QR	R12	4·7 M ½ W	V1	WIRED PURE 7S7
C13	·00025 MF MICA	R13	1500 Ω 8 W W W	V2	IF AMPLIFIER TYPE 7B7
C14	·01 MF 500 V QR	R14	15 K 1 W	V3	DET-AUD AMPLIFIER TYPE 7C6
C15	·00025 MF MICA	R15	100 K ½ W	V4	OUTPUT AMPLIFIER TYPE 7C5
C16	40-40-20 MF AEROVOX ELECTRO			V5	RECTIFIER TYPE 5Y4
C17	005 MF 500 V				PANEL LAMPS M.E.S. 6·8 V
C18	005 MF WAX PAPER				



FRONT VIEW OF DIAL STRINGING

GANG FULL IN
ARROWS SHOW DIRECTION OF STRING TRAVEL
AS GANG PLATES ARE TURNED OUT

To Radio Manufacturers and Coil Winders

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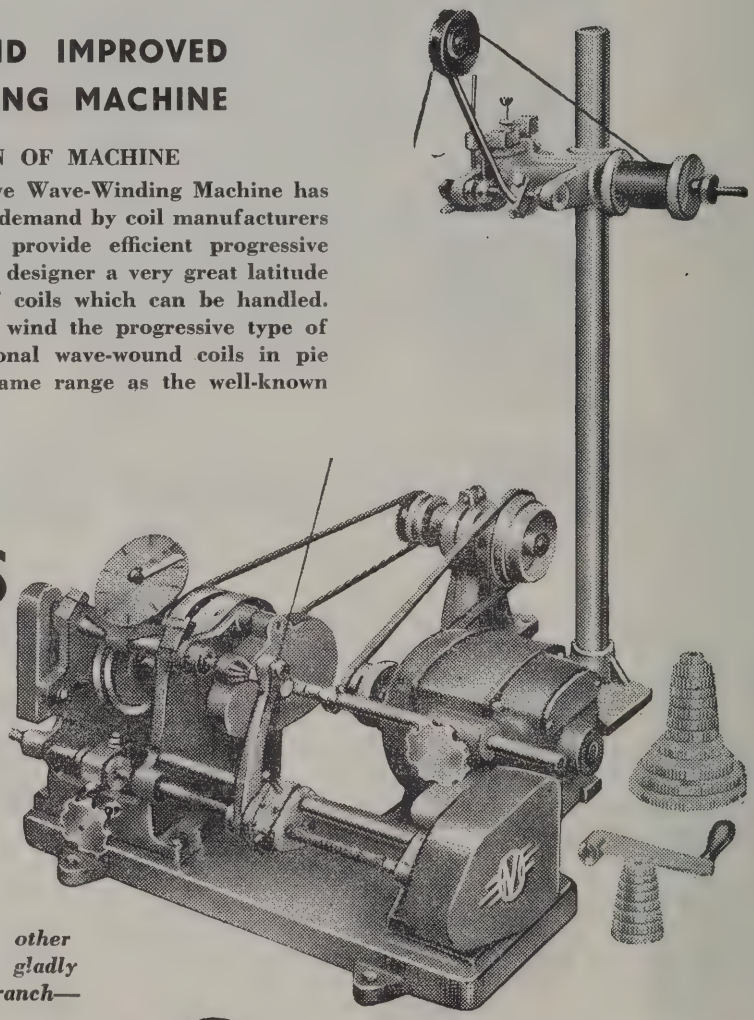
DESCRIPTION OF MACHINE

The "DOUGLAS" Progressive Wave-Winding Machine has been developed to meet the demand by coil manufacturers for a machine which will provide efficient progressive wave-wound coils giving the designer a very great latitude in the spacing and sizes of coils which can be handled. Not only does the machine wind the progressive type of coil, but also the conventional wave-wound coils in pie form with practically the same range as the well-known "DOUGLAS" Wave Winder



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V.H.F. FOR FIJI

After a tour of Fiji in connection with the installation of high frequency radio links to connect various settlements in the main and surrounding islands, Mr. A. M. Cooper, Director of Messrs. Green and Cooper, Ltd., has returned with much interesting information.

On account of the dense growth of creeper along practically the whole reticulation lines, the present system of ordinary telephone communication has always presented difficult servicing and maintenance problems. Apart from interference with the service, these creepers cause a wind resistance, often resulting in large stretches of line being blown down. In addition to this, the damage caused through falling trees often necessitates miles of tracking through rough jungle country to effect repairs.

With the hope of finding a more practical means of communication and utilizing, if possible, the developments of recent research with V.H.F., Mr. Cooper, in company with officials of the R.N.Z.A.F. and the Fijian Post and Telegraph Department, spent a week or so carrying out tests in various parts of the territory. Working with two sets of V.H.F. equipment mounted in motor cars, and stationary transmitters at various places where aerials could conveniently (or inconveniently) be installed, the party achieved very satisfactory results, proving V.H.F. to be the answer to the problem.

However, in the meantime, it is not intended to scrap the existing telephone systems in the main settlements. Rather will V.H.F. be used to augment this service, and provide, as full as possible a cover for the outlying districts.

Coincidental with the period of tests, a party from Messrs. Warner Bros. Film Company arrived in Fiji to film "His Majesty O'Keefe," and thus the first V.H.F. radio 'phone service was installed at Ndeumba, about 35 miles south of Suva, for the use of this party. Extremely high level signals were obtained in and out of Suva on simplex arrangement, and it was evident that no difficulty would be experienced in operating a complete duplex telephone link for use of the film party. This is now being installed, and will use the two base stations belonging to the Post and Telegraph Department there. Later, this link will be used by the Americans and will become part of a permanent link to Levuka.

Tests were undertaken from the mobile units in and around Suva itself, and ranges of 20 to 30 miles were obtained without difficulty.

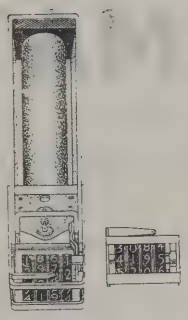
A good deal of time was spent testing reception from high ground of which much of this district is comprised. For the hill-interior test, a mill site was chosen, the location being Yoo, an elevation of 3,600 feet. Fortunately, this was fairly accessible by road for most of the way, and the owner of the mill co-operated by arranging for his manager and some native employees to clear a site and a track to the summit. To reach the site with the necessary equipment entailed a circuitous journey through hilly country, followed by an hour's climb through the jungle after leaving the road. Fortunately for Don, there was plenty of native labour available for the transport of the equipment, as he found it quite enough to drag himself through the thick tropical jungle. Asked if he was now in good training

SEW-TRIC GRINDER POLISHERS

Double-ended universal variable speed electric motors for Bench Grinding and Polishing. Five separate speeds on knob control; two models.

Cat. No. EU341, 1/15 h.p.— £6/4/6

Cat. No. EU342, 1/6 h.p.— £9/12/9



ELECTRO-MAGNETIC COUNTERS

Ex-Telephone Equipment; as new; 4-wheel type; self-contained electro-magnet; would operate from 45-volt radio battery (operational range 40/150 volts D.C.). By arranging a contact on a machine, counter may be put to many industrial uses. Size 5 in. x 1¼ in. x 1 in.

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MOTORS, ¼ h.p.

Split-phase Induction; 1440 r.p.m. English make. Shaft size ⅝ in. Cat. No. EM570— £7/13/6

CONDENSERS

8 mfd. Electrolytics; metal cased; Plessey; with clamps.

EX202: 450 volt wkg. dia. 1⅝ in. x 2½ in. long 1/6 each

EX203: 500 volt wkg. dia. 1 in. x 2 in. long— 1/6 each

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for Malaya, Don replied that at least he now has a better appreciation of some of the problems confronting our troops in that part of the globe.

The transmitting equipment, using a yagi aerial, was erected on the summit, and contact was soon establised with the Police Superintendent at Tavua some ten miles away as the crow flies. In the meantime, a party at the Suva end had established a base station, complete with yagi aerial and petrol generator, on the summit of a 700 ft. hill eight miles out of Suva, and communication was also made with the police at Tavua.

Later, further tests were made from the mill site at Yoo, this time using a mobile set in a Morris 8, and traversing the road from Tavua round the top of the island to Latoka, the second largest town. With the exception of a short distance of about two miles, good contacts were made over the whole route, maximum signals being received at both Latoka and Yoo, indicating the simplicity with which it will be possible to install at V.H.F. system between Latoka and Suva, with one repeater station at Yoo.

Further tests carried out during this visit have confirmed the opinion that V.H.F. will not only solve the problem of telephone communication for Fiji, but will also be of immense advantage to both the R.N.Z.A.F. and civil aviation in New Zealand.

Incidentally, Mr. Cooper has pointed out that the Fijians themselves are by no means unmindful of the advantages and uses of radio, for there are about 129 radio stations equipped with war assets materials established in the whole group of the Fiji islands. Courses for radio operators are available, and outposts are manned to maintain a radio watch and keep regular schedules with Suva.

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AUCKLAND WELLINGTON DUNEDIN

Philips Experimenter

(Continued from Page 25.)

and which necessitated longer R.F. wiring runs, a cross-chassis shield might be needed, to prevent radiation from the latter portion of the circuit from affecting the EF42 circuit.

ALIGNMENT

One very good reason for using the miniature Philips I.F. transformers in this job is the real necessity for transformers whose adjustments are easily made, without hand-capacity effects, and which will "stay put" for long periods. It is to be expected, in a circuit like this, that accurate adjustment of all I.F. trimmers is very necessary, and such is the case, although the alignment is not a bit difficult. It is simply a matter of very carefully peaking all five adjustments for maximum output, with the A.V.C. off, and with some sort of visual indicator. Any simple V.T.V.M. can be used to measure the audio output voltage from the high end of the detector load resistor, or the output can be fed into the audio amplifier, and the output of this monitored by a rectifier voltmeter, or the A.C. ranges of an ordinary multimeter. The best alignment procedure is as follows. C_3 is set at half-scale, and the signal generator or test oscillator, set to 455 kc/sec. is fed into the grid of the preceding valve (the mixer). The A.V.C. is made inoperative, and the selectivity control is set with maximum resistance in circuit. The inductance trimmers are then adjusted for maximum indication on the output meter, starting with the winding nearest the detector and working backwards to the input. This done, the selectivity control is advanced to about half way, and the circuits re-checked. The last I.F. transformer should not need any alteration, but may do so, since there is a very slight, but definite change in the frequency of the super-selective circuit when the selectivity control is operated. The fullest extent of this change is only 250 cycles, so it can cause little trouble, but this may cause just enough change in response at the last I.F. transformer to be noticeable. The input transformer and the EF42 grid coil are the ones that most care has to be taken over. After the first change in setting of the selectivity control, and the re-peaking of the circuits, the control is advanced once more, and the peaking carried out again. Do not be misled by the fact that when the selectivity control gets very near the oscillation point, a slight change in the tuning of the input transformer secondary will cause weak oscillations to start. This is quite normal, and is simply an indication of the very great selectivity, and stability, of the circuit. Indeed, the stability is such that the control can be brought so close to the point of oscillation that the slightest change in signal level is enough to start the oscillation. And yet, with no signal input, and the same critical setting of the control, the H.T. voltage can be run up and down without causing oscillation to start. This is rather a different sort of controlled regeneration from the conventional non-oscillating oscillator circuits that we have all been used to for so many years! Once the circuits have been set "on the nose" there will be no need to alter them for any reason. Please note that the fine tuning control C_3 plays absolutely no part in the alignment process, except to be set at half-scale and left. After this, the position of the pointer should be accurately marked, so that the condenser can be returned to the exact centre of the I.F. channel if necessary.

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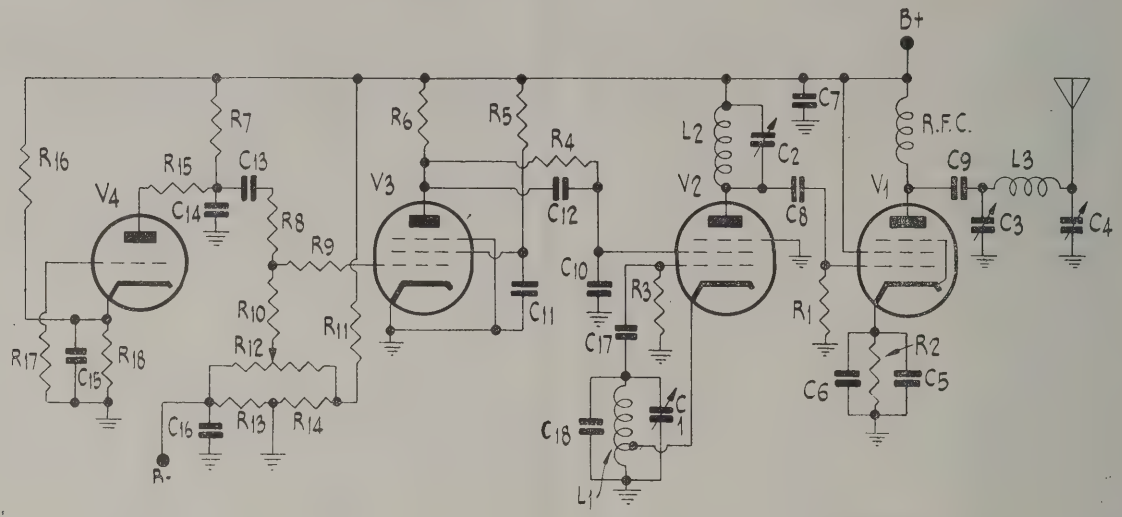
Some New Circuits for Radio Control Receivers—Part III

This article is the third and final part of the article which has appeared in these pages in recent months. The description of the mark-space ratio proportional control system is completed here, with details of the transmitter which produces the variable mark/space ratio signals.



In Part II of this series, which appeared in the June, 1952, issue of *Radio and Electronics,* we described the receiver for the proportional control system, and its principle of operation. Before going on to give details of the companion transmitter, there are one or two details about the receiver that might be of interest.

NO-SIGNAL PERFORMANCE

For the purpose in hand, it is highly desirable that the control should return automatically to its central position, both when the signal is returned to a unity mark/space ratio, and also when, for any reason, the signal is not present at the receiver. Some proportional systems which have been developed have had the inherent disadvantage that in the absence of all signal, the control goes hard over in one direction, and stays there; since there are numerous reasons, quite apart from equipment failure, why the signal might be lost temporarily by the receiver, such a system could be disastrous in actual practice. In addition, there is always the possibility of receiver failure. The system described here will automatically centralize the servo-mechanism as long as the failure is not in the servo itself. Under no-signal conditions, the two-stage squaring circuit acts to the super-regenerative noise output of the detector as a high-gain amplifier, with the result that the second squaring stage is fully driven by the amplified noise from the preceding stage. But since the noise is of a random nature, and is applied equally to both discriminator diodes, the D.C. outputs of these are equal, but opposite in polarity, and the D.C. output voltage to the control tube in the servo-mechanism is zero. From this it is obvious that in the absence of all control signals, the servo-mechanism must centralize itself.

MICROPHONICS

Another bug-bear of most equipment operated by low-drain filament-type valves is that of microphony. In early control receivers, which operated from the very small noise output of self-quenched super-regenerative detectors, microphonics was a considerable problem. This is because, after the detector, the whole receiver is an audio frequency device, of high amplification, and it so turned out that the desired signal—the noise—was of the same order of magnitude as the microphonic voltages set up when the set was subject to vibration. For a single-channel

COMPONENT LIST

V_1, EN31.
V_2, V_3, EF42.
V_4, EL41.
R_1, R_3, R_4, R_6, 50k.
R_2, 150 ohms.
R_5, 60k.
R_7, R_9, R_{10}, 1 meg.
R_8, R_{11}, R_{16}, 100k.
R_{12}, 50k. wire-wound potentiometer.
R_{13}, 350 ohms.
R_{14}, 15k.
R_{15}, R_{18}, 1k.
R_{17}, 25k.
C_1, C_2, 3–30 $\mu\mu$f. Philips trimmers.
C_3, 20 $\mu\mu$f. max. variable.
C_4, 400 $\mu\mu$f. padder condenser.
C_5, C_{14}, C_{16}, 0.01 μf.
C_6, C_{15}, 25 μf. 25v. electro.
C_7, C_9, C_{10}, 0.001 μf. mica.
C_8, C_{17}, 50 $\mu\mu$f. silvered mica.
C_{11}, 0.25 μf., 600v.
C_{12}, 0.1 μf. 600v.
C_{13}, 0.05 μf.
C_{18}, 100 $\mu\mu$f. silvered mica.

sequential control, such as the one described earlier in this series, undoubtedly the best answer to the microphony problem is to square-wave modulate the transmitter, thereby producing peak output voltages from the detector of the order of several volts, as compared with the noise output of some 50 millivolts or so. Under these conditions the amplification required from the audio amplifier-cum-relay-tube stage is so small that it is not possible for any microphonic voltages to have any effect on the operation of the receiver.

In the proportional receiver, the same situation obtains when the signal is being received, since both squaring stages are being purposely over-driven, and small interfering voltages are ineffective. With no signal, however, the squaring stages act as high-gain audio amplifiers, and the oscilloscope shows that microphonic voltages, as well as super-regenerative noise voltages, are able to swing the grid of the second stage well out of its normal grid base. This means again that the discriminator diodes are receiving large signal voltages, but that since these are random in shape, the net output from this circuit is still zero, and neither microphonics nor noise affect the automatic centralization of the control.

While these things may appear to be somewhat extraneous details, they are of the kind which can cause much trouble in practice, and indeed, can prevent any control system from functioning at all if they are not taken care of either by circuit design, mechanical design, or both. Of course, the vibration referred to is that of miniature petrol or "diesel" motors, used to power the models concerned. Even in applications not concerned with models, these problems must be guarded against. For example, should the same general control system be used as part of a tele-metering device, or incorporated in heavy machinery where vibration is encountered, microphony will be just as important, and its probability should not be overlooked, even where filament type valves are not used.

THE MARK/SPACE RATIO TRANSMITTER

There are a number of possible ways in which an R.F. signal may be produced, pulsed at a variable mark/space ratio, but at fixed frequency. Perhaps the simplest is to use a multivibrator with a control for varying the mark/space ratio. Simplest in theory, that is; but this is a case where the simplest answer is not the best, by a long way. The multivibrator is very difficult to make in such a manner that smooth, continuous control over the mark/space ratio is obtained, without any change in the frequency. Some sort of control is possible, but it is far from ideal, as the shape of the pulses, especially at the extreme ends of the control, is not good.

After considerable experimentation with multivibrators, which were attractive on account of the simple nature of their circuitry, it was decided to use as a modulator a squaring stage, driven on the grid by a saw-tooth. If this is done, variation of the bias of the squarer from high negative values to large positive values, theoretically enables either positive or negative pulses, as short as we please, to be obtained with linear and continuous variation from one to the other, through one-to-one mark/space ratio. Such a modulating system is not difficult to design, particularly if no restrictions are placed on the number of valves that may be used, so that most of the initial difficulties encountered were associated with the determination to use only one valve as the saw-tooth generator, and one as the modulator. Finally, the scheme chosen was to use a gas-triode saw-tooth generator, as giving the largest reasonably linear output voltage from a given H.T. supply voltage. This is followed by a high-slope pentode, as the squarer and modulator.

The R.F. end of the transmitter also contains two valves. V_2 is an oscillator-doubler, exciting V_1, which is a doubler also. In this way, the oscillator is enabled to work at one-quarter of the output frequency, in a high-C oscillator circuit, both these features contributing materially to frequency stability. The main object of running the output stage as a doubler was to avoid the use of a "straight" amplifier stage, which, at the output frequency of 35.7 mc/sec., would almost certainly require neutralizing if one of the smaller A.F. pentodes were used in this stage. The output given by the EL41 as a doubler is ample for the purpose in hand, being approximately 4 watts at a plate voltage of 250.

Because of all this, the oscillator operates at 8,925 mc/sec., its plate circuit is tuned to 17.85 mc/sec., and the output circuit is 35.7 mc/sec.

CIRCUIT DETAILS

The saw-tooth oscillator, V_4, is an EN31. It will be noticed that no provision is made for varying the saw-tooth frequency, the determining elements R_7 and C_{14} both being fixed. The fixed bias, provided by R_{16} and R_{18} is of the lowest possible value consistent with reliable starting of the oscillations, since this condition is also the one for greatest saw-tooth output voltage. The linearity of the saw-tooth is not remarkable, as is to be expected under these conditions, but is linear enough to give the output a substantially linear variation of mark/space ratio, with movement of the control potentiometer, R_{12}. The latter is a 50k. wire-wound unit. One end is attached to the junction of R_{11}, and R_{14}, giving it a potential of about 22½ volts. The other end of R_{12} is connected to a back-bias resistor which provides a similar negative voltage. In this way, the bias on V_3 can be varied between the limits of 22½ volts. Since the peak-to-peak output voltage of the saw-tooth generator is just under 45 volts, this amount of bias variation enables both the positive and negative peaks (at different times, of course) just to extend into the working portion of the characteristic of V_3. When the bias is negative, V_3 conducts for only the brief period during which the input waveform comes within the grid-base of the valve, so that the output consists of negative-going pulses. As the negative bias is reduced, the time during which the input wave enters the grid-base of the valve is increased, so that the negative pulses last for a longer proportion of the time of the one whole saw-tooth cycle. When the bias is somewhere near zero, the valve is conducting for half the time, and the negative pulses have degenerated into a square-wave of one-to-one mark/space ratio. As the bias is moved further in the positive direction, the valve becomes conducting for the greater part of the time of one cycle, and the output becomes positive-going pulses which become shorter as the positive bias is increased. If the bias voltage in either direction can be made greater than the peak voltage of the input saw-tooth, then a point can be reached where the modulator valve is cut off, or conducting, permanently. Then the transmitter will be producing unmodulated C.W., or nothing at all, respectively.

In the diagram, the oscillator V_2 has its screen-grid directly coupled, through R_4 and C_{12}, to the plate of the modulator valve. This scheme is simple, and works well except at extremely narrow output pulses, the reason

being that under these conditions, the pulse amplitude begins to fall off, and allow the oscillator to work weakly during what are officially the "off" periods. Although the range of operation is quite satisfactory as things are shown, the prototype has been modulated to provide a little grid modulation simultaneously with the screen modulation. This cleans things up, and it is possible to obtain perfect pulsing at any desired mark/space ratio.

It will be noted that the output stage V_1 is given cathode bias. This is almost essential, and results in the H.T. drain of the whole transmitter remaining almost constant, regardless of mark/space ratio. This is necessary in order to avoid changes in the frequency of the saw-tooth oscillator, which would occur when the H.T. voltage varied in sympathy with H.T. currency changes. Naturally, the D.C. plate and screen currents of V_1 and V_2 vary when the modulation is varied by R_{12}.

The output coupling arrangement is intended to feed a vertical quarter-wave aerial at the output frequency, and is the well-known section coupler. It enables an excellent match to be obtained to the approximately 37-ohm impedance of the aerial, and has the further advantage that C_4, being large in value, provides a virtual short-circuit to earth for voltages far removed from the resonant frequency of the output circuit. Radiation of harmonics and sub-harmonics is thereby minimized.

COIL DATA

The coils used in the R.F. portion of the transmitter were as follows:—

Oscillator: 14 turns 30-gauge S.C.C., double-spaced on a $\frac{1}{2}$ in. former. Tap at 3 turns from the ground end.

Oscillator Plate: Same as above, except that it is untapped.

Output Coil: 8 turns of 16-gauge tinned copper wire, $\frac{3}{4}$ in. in diameter, spaced to occupy $\frac{7}{8}$ in.

SUMMARY OF THIS SERIES

A brief analysis of the performance of previous radio control circuits was given in Part I, together with a description of work done in the laboratory of this journal on developing improved circuits for simple sequential control systems. In Part II it was shown how these developments led naturally to the devising of a fully proportional control system working on the mark/space ratio variation principle. The receiver and transmitter described in Parts II and III are for a single control, such as rudder, in a model, or the position of any shaft that needs to be remotely set, for any purpose whatever. The system is inherently capable of being elaborated by well-known techniques to embrace any desired number of controls, using the same radio frequency carrier, the only limitations being those of size, weight, and power consumption.

When in 1941 H.M. Government decided to standardize R.F. Cables for all the three Services, Telcon designs were adopted almost throughout the range—thus forming the basis of world standards in Service equipment. Since then, research and development have continued apace, the lead established by Telcon in the design of truly flexible low-loss R.F. Cables having been consolidated by important additions and improvements.

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THIS SHAKING WORLD

During recent weeks, metropolitan newspapers have given up top line news to shakes in Auckland. Centre of thrills, qualms, and alarms was Radio (1936) Ltd. As the news spread, so did the confusion, and somehow the vibrations of a presumed rocky building became mixed with the sterling crisis, giving rise to the rumour concerning shaky finances of Radio (1936) Ltd. This was firmly quashed by Radio (1936) informing anxious inquirers that they had so much dough they were putting it through the mixer!

Overwhelming pressure on the Post and Telegraph Department in delivering the enormous mail over the rickety period was evidently too much, resulting in curious mutilations of telegrams, such as the following received by telephone:—

"BEFORE DEMOBILIZATION STOP APPRECIATE ADVICE GIVING YOUR DEALERS OPPORTUNITY ACQUIRE STOP."

When delivered, the original read:—

"BEFORE DEMOLITION STARTS APPRECIATE ADVICE GIVING YOUR DEALERS OPPORTUNITY ACQUIRE STOCKS."

Quick in their repartee, Radio (1936) replied:—

"BUSINESS EXPANDING SO RAPIDLY IT IS PUSHING OUT THE WALLS ALSO ARE SHAKING WITH EXCITEMENT OVER RELEASE NEW MODELS AND WE ARE STILL STEPPING ALONG WELL STOP."

According to one correspondent, owing to the moon being in conjuinction with a powerful star, and there being high tides, the moon was trying to pull the building up by the roots!

After hearing telephone news of the "shaky" condition of Radio (1936) from a friend, one supplier suffered a mild heart attack, but was restored to good health when a perusal of the evening paper revealed the true news.

Well, we suppose it is good to have a laugh after the events, but from all accounts, it was no laughing matter at the time, and Radio (1936) express their grateful thanks for the help and advice so unstintedly given by well-wishers during this particularly worrying period.

* * *

In June, Collier and Beale, Ltd., announced the appointment of Martin Kimble, A.M.I.R.E.(Aust.) as Technical Director.

Born in Invercargill in October, 1918, Martin made an early start to his career, being encouraged by an article in the "Meccano Magazine" to build his first set at the age of ten. After an education at the Southland Technical College, he spent four years in servicing and P.A. work with A. E. Jordan's, of Invercargill. Prewar, he operated ZL4GO, using V.H.F. for communication, and milk pasteurization!

In 1939 he joined Collier and Beale, Ltd., working under Mr. B. T. Withers on transmitter construction, drafting, and laboratory measurements. Later, he served for a 2½-year period in the telecommunications group of the State Hydro-electric Department, this providing much experience in design, propagation surveys, carrier working, and specification writing.

In 1949 he rejoined Collier and Beale in a supervisory capacity, this time concerned with developments of domestic receivers, special apparatus, plastic products, and R.F. heater sales.

We extend to Martin our very best wishes for every success in his new post.

* * *

We also offer our congratulations to Mr. Albert Larsen, newly promoted to the position of Production Officer in Collier and Beale, Ltd., and to Mr. Peter Pooley of the same firm, who is now Costs and Works Accountant.

NEW TECHNICAL ADVISORY COMMITTEE OF THE DOMINION PHYSICAL LABORATORY

The Minister-in-Charge of Scientific and Industrial Research recently approved the appointment of five new members to the Technical Advisory Committee of the Dominion Physical Laboratory.

This committee was previously reorganized just after the last war, its purpose being to advise and assist the Director of the Laboratory on matters of engineering and physical research.

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The new committee consists of Mr. L. B. Hutton (chairman), Mr. F. T. M. Kissel (deputy chairman), Messrs. R. Slade, K. Pallo, A. P. O'Shea, P. Laing, C. R. Hope, Dr. E. F. Cooper, and Profs. Chalkin, Nimmo, and Mowbray.

This representation covers wide interests in industry, agriculture, universities, research associations, government departments, and electrical supply authorities.

The radio industry will welcome the appointment of that well-known personality, Ralph Slade. In this new sphere, Mr. Slade, with his long and vast experience of the manufacture and marketing of domestic radios, as well as his special qualifications in design and research, will enjoy the fullest confidence of the industry.

* * *

Eyes on Waitomo on 18th and 19th September, when the New Zealand Radio and Television Manufacturers' Federation will meet for its annual conference.

* * *

N.Z. RADIO TRADERS' FEDERATION

Popular new President of the New Zealand Radio Traders' Federation is Noel Souper, appointed at the last annual conference in Dunedin.

Commencing as a licensed radio dealer and serviceman in 1926 Noel Souper joined the staff of Sexton

Mr. N. Souper.

Radio Co., Ltd., of Auckland in 1931, and was there for two years before moving to Christchurch to the Rola Manufacturing Co., where he remained until 1941. In January, 1942, he returned to Wellington where he joined the staff of Philips Electrical Industries of New Zealand, Ltd., as personnel officer at Philips Radio Factory.

A man of many interests, he has served as President of the North Island Manufacturers' Assemblers' and Servicemen's Industrial Union of Employers, and has also been a member of the New Zealand Radio Apprenticeship Committee.

On the sporting field he has served for 11 years as a Rugby football referee in Wellington and Auckland, and at cricket he played for Wellington College Old Boys from 1919 to 1928. Now his relaxations are of a less strenuous nature, and at snooker he is a champion, but alas he met his Waterloo at Dunedin.

Eclipsed in length of service in the radio trade in Dunedin only by Messrs. A. G. McCarthy and K. A. Shiel, Mr. A. J. Howorth, the new Vice-president of the New Zealand Radio Traders' Federation, commenced his career in the radio trade with the firm of Laidlaw and Grey, Ltd., Dunedin, on 10th May, 1927.

Working under his first boss, Jim McConnell, better known as Berny McConnell of 4ZB, A.J.'s proudest moment was his first sale—a Polar Twin for £11 11s.

Closely associated with several of the private broadcasting stations in Dunedin, including 4ZM—the Radio Church of the Helping Hand—Mr. Howorth ran 4ZF until it closed down. 4ZF had two distinctions. It provided the first morning devotional service in the South Island, and it used "Now is the Hour" as its signature tune, long before the song achieved its present fame. In fact, Mr. Howorth still has in his possession one copy

Mr. A. J. Howorth

of this record, which has been played over 850 times.

In 1933 he commenced business on his own account, and is still going strong. Amongst his many and varied interests has been the Radio Traders' Federation, of which he has been president of the local branch.

From the ladies' point of view, amongst the highlights of the recent Dunedin conference was a drive round the hills of Dunedin, followed by morning tea at the Otago Women's Club, a visit to Larnach's Castle with afternoon tea at Highcliff, a drive to the Centennial Memorial, and, of course, the social evening at the Savoy.

On behalf of the visitors, Mrs. Souper, during a recent interview, has asked us to express thanks and appreciation to the generous hostesses who made the ladies' stay in Dunedin so enjoyable.

Stolen Radios

Criminal Investigation Branch, Auckland

One car radio, Motorola, control panel 8 in. x 2 in. x 2 in., black metal container, white dial face, red pointer and dots indicating stations; two cream plastic knobs, left one faulty. Speaker 9 in x 7 in. in cream metal container, brown plastic grille front. Model 405, Serial No. 4/2822. Identifiable.

"Westco" portable, model 1,207, serial No. 12479, licence No. 1884, 5-valve A.C. and battery, 14 in. x 9 in. x 6 in., silver and gold plastic cabinet, cream grille front, three tuning knobs, plastic carrying handle on top. (New set.)

Corrections to reports published July *Radio and Electronics,* page 35:

Pacemaker serial number is 67453.

Motorola car radio number is 3133 over 4.

Criminal Investigation Branch, Christchurch

H.M.V. "Little Nipper" 5-valve broadcast, green plastic case, 7 in. x 9½ in. x 6 in.; dial full width of case, two control knobs below speaker grid. Serial No. S/11706.

Police Station, Dunedin

Five "Ekco" 5-valve radios, Model U153, serial Nos. 2748, 2777, 3556, 3746, and 3821, all in red plastic cabinets 12 in. x 7¼ in. x 6¾ in. Three control knobs per set.

Criminal Investigation Branch, Hamilton

Mullard portable, model 681, serial No. either 50587 or 50613, red leather case with ivory plastic on back. and front, 5-valve battery and power operated.

Mullard mantel model 420, serial No. 12743, 4-valve, electric. Ivory plastic case.

Police Station, New Plymouth

Columbus, covette cabinet, model No. 53, serial No. 74324, 5 valves, 12½ in. x 18 in. x 9 in. Cabinet walnut veneer on laminated wood, clear lacquer finish.

Cromwell radio, upright mantel 18 in. x 14 in., round dial, 4 knobs, light walnut colour, six valves. Serial No. 5849. Two pin points burnt in dial plate.

Police Station, Timaru

Austin Midget, No. 526159, 5 valves, walnut colour case. Maker's name incorporated in design resembling Air Force wings.

PYE TELEVISION FOR SWITZERLAND

The first Swiss television station will be fitted with British equipment manufactured by Pye Limited of Cambridge.

As a result of the recent visit to Switzerland of the Pye technical and export directors, Pye cameras will be used to bring the first television pictures to Swiss viewers. The equipment was ready for delivery in May, and transmissions are expected to commence towards the middle of 1952.

Switzerland is planning an extensive television network with five stations at Zurich, Berne, Geneva, Lausanne, and Lugano. This contact represents a great achievement for British exports, and has opened up a £100,000 television market which has not yet been touched. It is hoped that other stations will use British equipment once this Pye installation has proved satisfactory.

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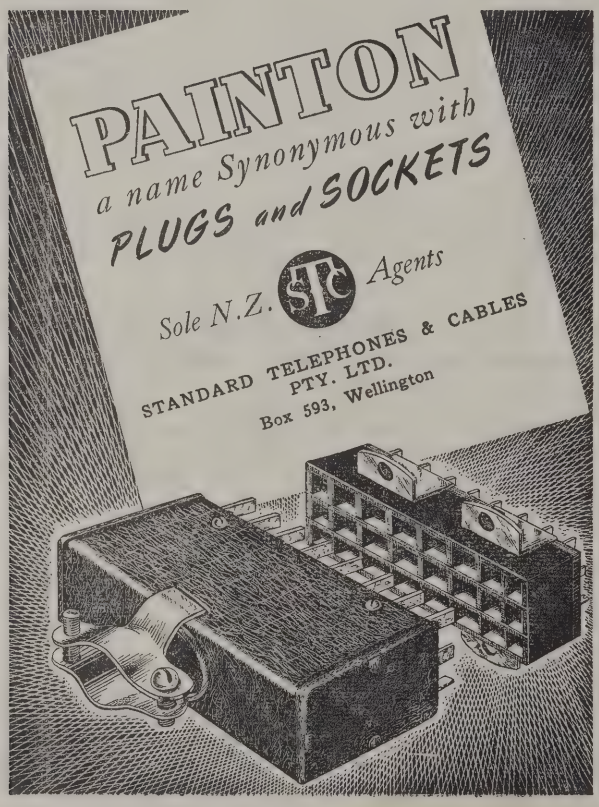

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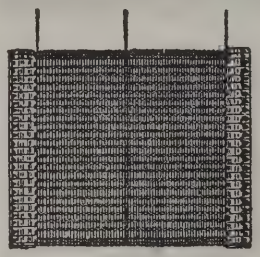

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57 Wyndham Street, Auckland
New Zealand Distributors for
The Cressall Manufacturing Co., Ltd.,
Birmingham, England.

Proceedings of the New Zealand Electronics Institute Incorporated.

Headquarters News

By the time these Proceedings have been published, the Institute Annual General Meeting will have been held and a new Council elected, arrangements having been completed for the Annual General Meeting to take place on Wednesday, 30th July, 1952, in the Air Department Building, Bunny Street, Wellington.

As soon as possible after the Annual Meeting a Council meeting will be convened and details of business transacted at this Council meeting will appear in the next Proceedings to be published.

Rutherford Memorial Fund

The final meeting of the Wellington Appeal Committee was held on Tuesday, 22nd April, 1952, in the Shell Theatrette, A.M.P. Building, at 5 p.m. The total receipts to date approximated £2,000 and a further £500 has been sent direct to Christchurch.

Visit of Sir John Cockcroft

It was agreed that a public evening lecture should be held under the auspices of the Wellington Scientific Society and that the Chairman of Victoria University College be asked to act as Chairman. In concluding the business of the meeting the Chairman thanked all those who had been associated with the work of the committee and it was also agreed that a letter be forwarded to the Wellington Manufacturers' Association expressing appreciation of their interest and assistance.

Christchurch

The Annual General Meeting of Christchurch Branch was held in the Electrical Lecture Room of the Canterbury University College at 7.30 on Monday, 9th June. The election of officers resulted as hereunder:

Chairman: Squadron Leader A. L. Partelow, 11 Rex Street, Riccarton.

Deputy Chairman: Mr. R. G. Tulloch, 56 North Road, Papanui.

Secretary: Mr. S. P. Willis, 1 Gamblins Road, St. Martins.

Treasurer: Mr. J. A. Lee.

After the Annual Meeting a talk was given by Mr. E. J. Boyce on "The Investigation of Cosmic Radiation" and details of this address will be appearing very shortly.

Dunedin

The Annual General Meeting of the Dunedin Branch was held in the Jubilee Hall, View Street, on Thursday, 19th June, 1952. Officers for the year 1952–53 were elected as follows:

Chairman: Mr. W. L. Shiel.
Vice-Chairman: Mr. H. F. Symmons.
Hon. Secretary-Treasurer: Mr. W. McInnes.
Committee: Messrs. Andersen, Collett, Hall, and Holden.
Social Committee: Messrs. Stone, Clarke, and Holden.

At the conclusion of the election of officers, those present expressed their keen appreciation of the work done for the Institute by Messrs. Shiel and Symmons and a hearty vote of thanks to the Social Committee for their services during the past year was also carried with acclamation.

Following the business of the Annual Meeting some films were screened by Mr. E. S. Anderson. The title of these films were: No. 1, Electric Propulsion at Sea; No. 2, Manufacture of Miniature Valves; No. 3, A.C. Welding; No. 4, The Manufacture of Radio Valves.

These films were followed by keen interest by members, and the serving of supper brought the evening to a close.

Wellington

The Annual General Meeting of the Wellington Branch was concluded on the 26th June ,1952. Election of officers resulted as hereunder:—

Chairman: Mr. L. W. Hurrell.
Vice-Chairman: Mr. D. Foster.
Secretary: Mr. H. M. Scott.
Treasurer: Mr. J. D. McCormick.

Committee Members: Messrs. W. J. Askey, K. B. Gilby, F. W. Cropley, D. L. Rushworth, F. R. W. Andrews, E. T. Firth.

Council Members to Represent Wellington Branch: Mr. L. W. Hurrel, Mr. J. D. McCormick.

Wellington Branch Nominations for Council Members to Represent Country Districts: Mr. D. Foster, Mr. F. R. W. Andrews.

ERRATUM NOTICE

We regret the inclusion of several errors on the "Proceedings" for June, 1952.

The lecture on "Starvation Circuits" was given to the Dunedin branch by Mr. H. F. Symmons, not Mr. H. E. Symmons, as published.

On the turnover on page 48, the first sentence should read:—

"It was pointed out by Volkers (Electronics, March, 1951) that for a 6SJ7 μ increases from its normal value of 1650 at 3 m.a. anode current to a maximum of 9000 at about 11 μa. anode current, while the internal impedance varied from 1 megohm at 3 m.a. anode current, to a maximum of 100 megohm at about 3 μa. anode current."

In the third paragrapht of this same turnover on page 48, sub-para. 3 should read:—

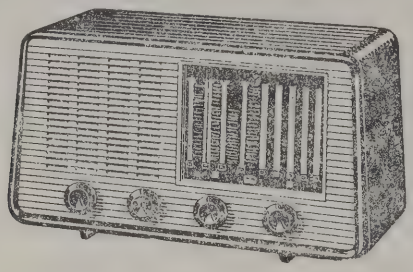
"Owing to the very high value of the anode load (about 30 megohms) the band width of a starved amplifier is only about 1.5 kc/sec., but this could be improved by sacrificing gain in using negative feedback."

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE PYE MODEL "G" FULLY BANDSPREAD

In the Model "G" Pye have an outstanding radio for the serious listener. No other set on the market at the



time of going to press can claim full bandspreading on all of eight wavebands. Waveband coverage is: Medium short, 36–97.8 metres; and short wavebands 11, 13, 16, 19, 25, and 31 metres, and, because of the full bandspreading tuning on any band is simple and accurate.

Pye Model "G" is designed for 230v. 50-cycle A.C. power with a power consumption of approximately 40 watts. The tone variations on this excellent 5-valve receiver are Radio and Gram: Fidelity, Brilliant, Mellow, Speech. The loudspeaker is of the 6.5 in. P.M. moving-coil type and sockets are provided for an extension speaker of 2–4 ohms impedance. Sockets are also provided for use with any normal type of magnetic pick-up, either for "standard" (78 r.p.m.) or long-playing records.

The cabinet of the Model "G", type PZ 39, is attractively finished in moulded plastic with a white plastic grille while the scale is illuminated and multi-coloured with all important station names clearly marked; waveband inidcation is incorporated.

The Model "G" is fully tropicalized and retails at the amazingly low price of only £31 10s.

Further details and full technical information are available from Pye (New Zealand) Ltd., Box 2839, Auckland.

* * *

THE ULTIMATE 6-VALVE DUAL-WAVE TABLEGRAM

The new Ultimate model illustrated below compares more than favourably in both performance and price with any make or model in its range.

The Ultimate 6-valve Dual-wave Tablegram cabinet is of very suitable proportions and employs a 3-speed automatic Garrard RC72A record-player and has superb tone.

The use of an elliptical speaker raises the tonal response of the unit to that found usually in much

larger cabinets whilst still permitting a reduced cabinet height more proportionate to modern ideas and demands.

For convenience the Ultimate Tablegram incorporates its gramo switch in the wave-change switch being located on the right-hand side of the cabinet. A similarly placed tone control switch on the left-hand side is of the continuously variable type.

The Garrard RC72A 3-speed record-playing unit has a lightweight arm with crystal head pick-up with standard and microgroove playing styluses.

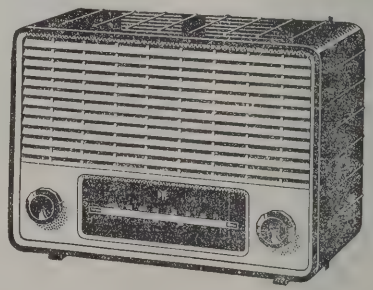
Simplified tuning on both broadcast and short-wave bands is accomplished by means of an open slide-rule dial and clear vision calibrations.

Specifications:

Frequency range: 1500 kc/sec.–550 kc/sec.; 18 mc/sec.–6 mc/sec.
Output: 3 watts.
Consumption: 50 watts.
Speaker: Rola 6-9H.
Gramo unit: Garrard RC72A.
All the lowboy features; world-wave; 3-speed player; large speaker; price £63 7s. 6d.

* * *

THE PYE MODEL "Y" 4-VALVE BROADCAST



At 17 guineas, the Pye Model "Y" is aptly described in the national advertising as "An attractive proposition." This 4-valve receiver brings top quality radio within the reach of all, and is fast becoming one of the most popular models on the market, for a number of excellent reasons. The receiver is of a neat compact design, 11½ lb. weight, and measuring 11¾ in. x 6¼ in. x 9 in. It is easily transportable from room to room—

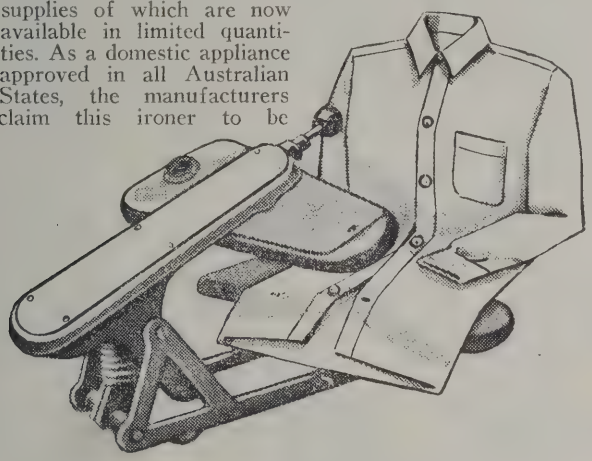
the ideal utility set for every time. The cabinet itself is attractively moulded in contrasting colours—mottled walnut with cream grille work. For a 4-valve receiver, the range and power of the Model "Y" are remarkable, with a degree of sensitivity seldom achieved in a set of this size. All programmes are reproduced with true to life fidelity, through a 6 in. x 4 in. elliptical P.M. moving coil speaker. The complete broadcast waveband is covered, from 1600 to 550 kc/sec., on a multi-coloured calibrated scale, with all New Zealand stations clearly marked.

This new model in the Pye range, produced by Pye (New Zealand) Ltd., is among the best small-set value ever offered in New Zealand, and is being acclaimed by everyone who uses it. Further details and full technical information are available from Pye (New Zealand) Limited, Box 2839, Auckland.

* * *

NEW DOMESTIC IRONER, "EZY-PRESS"

Under licence from the manufacturers, Shelford Engineering Company Pty., Ltd., Sydney, Australia, Bradley's Electrical Co., Ltd., Wellington, is making at its Masterton factory this new type of domestic ironer, supplies of which are now available in limited quantities. As a domestic appliance approved in all Australian States, the manufacturers claim this ironer to be



unique, for it is fully controlled and operated by a single lever—the only such machine of its kind in the world! So simple is it to use that a mere finger pressure on the control lever suffices to operate the ironing head at the required pressure for all types of articles to be ironed. Whether these be silks or woollens, no special adjustment is required, and the speed of operation is such that, with little practice, as many as 28 assorted articles from dainty lingerie to heavy trousers can be ironed within one hour.

The large ironing surface of 24 inches by 10 inches is a head plate of polished silicon aluminium, heated by robust elements for 240 volts, 1250 watts A.C., thermostatically controlled. The ironing board of marine bonded plywood to prevent sweating and condensation, and specially shaped to accommodate difficult garmetnts, is covered with resilient cotton padding and a heavy washable cover. The head, described as "floating self-aligned," is designed to waft away steam from the front of the ironer. Smooth, trouble-free operation is ensured by the special pre-loaded graphite bearings.

Of attractive appearance, the cover plates and framework are in durable wrinkle green enamel finish.

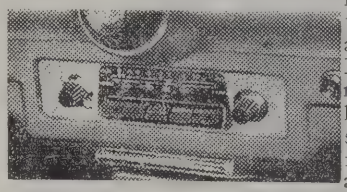
The "Ezy-Press" domestic flat plate ironer is Registered Prov. Patent Nos. 37704/40, 37705/50.

NEW AUTO SET RELEASED BY H.M.V. (N.Z.) LTD.

SMITHS RADIOMOBILE

6-Valve Model 4202

This model push button control auto-radio is standard fitting for most English manufactured automobiles. There is a "Radiomobile" individually designed for almost every make of English car, the automobile manufacturers having made special structural provision to facilitate the mounting and fitting of these instruments which tone in with the general dash-board design of each particular vehicle.



The aerial supplied with this auto-radio has also been designed to harmonize with the appearance of each make of car. Provision is made for the installation of an extra speaker in the rear compartment of the car, thus providing uniform listening pleasure at little extra cost.

"Radiomobile" service agencies have been established throughout New Zealand and other parts of the British Empire where owners of these instruments can be assured of receiving a high-grade courteous service. This set is marketed in certain other countries, notably North and South America, as Emition Car Radio.

SPECIFICATIONS

Five adjustable tuning push buttons, manual tuning control in addition. Variable tone control. Power output, 3 watts. Power consumption, 2.7 amperes at 12 volts. Frequency range, 525-1600 kc/sec. Low tension supply non-synchronous 4-pin vibrator with hard valve rectifier. Fuse, 5 amperes. Scale illumination lamps, 12 volts 0.2 amps.

Valve Complement

Control unit Emition W77, R.F. amplifier; X78 frequency changer.

Amplifier unit Emition W77, I.F. amplifier; DH77, detector, A.G.C. and A.F. amplifier; N78, power output; U78 full-wave rectifier.

Physical dimensions: Height, 2 3/16 in.; width, 7¼ in., depth, 8⅛ in. Weight, 4¾ lb.

Amplifier dimensions: Height 4½ in.; width 7 15/16 in.; depth, 6 in. Weight, 6 lb.

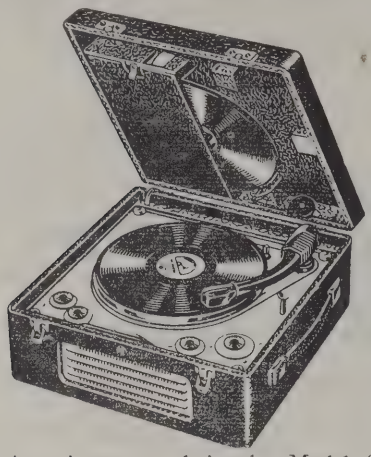
* * *

THE PYE MODEL "R" PORTABLE RADIOGRAM

This excellent little radiogram is getting press publicity under the heading "No Stay-at-Home," which is certainly true of a handy little model that weighs only 21 lb. Pye's Model "R" (or more accurately Type PZ 32 QTG) has all the refinements of many a full-sized radiogram. A three-speed motor permits the playing of microgroove 45 r.p.m. and 33 ⅓ r.p.m. long-playing discs as well as the standard 78 r.p.m.; while the stylus and pick-up head are designed for faithful and clear reproduction at any of the three speeds.

New Products

(Continued from previous page.)



The receiver incorporated in the Model "R" fully lives up to the reputation for reliability, value and general excellence that Pye has enjoyed for many years in the "Old Country," and which Pye (New Zealand) *Ltd.* is steadily building up in New Zealand. It covers the broadcast band from 550 to 1500 kc/sec., and is designed for 230 volts, 50-cycle A.C. power.

All essential parts of the "R" are fully tropicalized; the loudspeaker is a 6 in. x 4 in. elliptical permanent magnet moving coil; and the whole is housed in a ruggedly constructed wooden cabinet finished in dark blue art leather and trimmed with dark blue fittings and light blue grille. The controls and motor under the lid are easily accessible. Dimensions 6½ in x 14⅝ in. x 14⅝ in. The price is only £37 10s. Further details and full technical information are available from Pye (New Zealand) Ltd. Box 2839, Auckland.

* * *

H.M.V. (N.Z.) LTD. ANNOUNCE 1952 MODEL "LITTLE NIPPER"

5-Valve Broadcast Radio (Model 525 B.C.)

This new compact little mantel radio has been exclusively designed as "an extra radio for the home." Available in ivory or walnut coloured bakelite cabinets, it lends itself to suit any room in the house and its size is such that it will fill that odd corner admirably. Powered with five of the latest radio valves, the "Little Nipper" will give a performance and tone unequalled in the smaller sized radios.

SPECIFICATIONS

Valve Complement

(1) 7S7	....	Mixer
(2) 7B7	....	I.F. Amplifier
(3) 7C6	....	Detector and 1st Audio
(4) 7CS	....	Rectifier
(5) 7Y4	....	Output

Frequency Range

(a) Broadcast	.....	535 kc/sec. to 1540 kc/sec.
(b) I.F. frequency		455 kc/sec.

Power Supply

Mains	....	230 volts A.C.
Power consumption		23 Watts

Audio Output

1.5 watts

Cabinet

Height, 7½ in; length, 12 in.; depth, 5½ in.

ABSTRACT—— 8C3R·

THE "STANDARD" D.C. MILLIWATT CALIBRATOR

The testing and calibration of thermocouples demands a highly accurate and stable source of low level power. From the viewpoint of accuracy and stability, the obvious basis for such a source is a standard cell, but for testing and calibration purposes a means must be found of obtaining appreciable power for any length of time. This problem has been successfully solved by Standard Telephones and Cables Limited in their 74131-A D.C. Milliwatt Calibrator which uses a Muirhead Miniature Weston Standard Cell Type D-550-A as the reference voltage in a circuit which places no load upon it.

The Standard cell E.M.F. is applied between one of the grids of a double-triode valve and earth, and a voltage derived from a potentiometer network supplied with stabilized D.C. is applied to the other grid. By adjustment of the potentiometer resistance, this voltage can be made equal to the standard cell voltage, and then used as a reference voltage, against which the standard output of 1 mV. into either 600 or 75 ohms can be checked.

The Muirhead cell was chosen because it combines a high degree of accuracy and stability with robust mechanical construction, and because it is cheap to replace should this be necessary.

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PUBLICATIONS RECEIVED

Tentative Data, Radiotron 6AE8 triode-hexode converter and 6BV7 duo-diode amplifier pentode. (Amalgamated Wireless Valve Co., Pty., Ltd.)

Catalogue, Loudspeaker, the Plessey Company Lt., England.

Catalogue, Capacitors, British Insulated Callenders Cables Ltd. (National Electrical and Engineering Co., Ltd.)

Catalogue, Cored Solder, H. J. Enthoven & Sons, Ltd. (W. G. Leatham & Co., Ltd.)

Folder, Hartley Turner 215 Speaker, H. A. Hartley Co., Ltd., England. (A. G. Lawford & Co.)

Sales Literature—Appliances, Clocks, etc. (Electric Lamphouse, Ltd.)

Catalogue, Electronic Valves for Transmitting Industrial and Special Purposes—Edison Swan Electric Co., Ltd. (National Electric and Engineering Co.).

Radiotronics, May and June, 1952—Amalgamated Wireless Valve Co., Pty., Ltd.

The Scanner, February, 1952.—Decca Radar Ltd., England. (Electronic Navigation, Ltd.)

R.I.C. Amendments to Specifications RIC/111, RIC/112, RIC/113, RIC/131, and RIC/132.—The Radio Industry Council, London.

Electrical Communication, December, 1951.—International Telephones and Telegraph Corp., and Associate Companies, U.S.A. (Standard Telephones and Cables, Pty., Ltd.)

Sylvania News, April, May, 1952.—Sylvania Electric Products, Inc. (G. A. Wooller & Co., Ltd.)

Westinghouse Engineer, January, 1952, Westinghouse Electric Corp., U.S.A. (H. W. Clarke (N.Z.), Ltd.).

Stock and Price Lists "Radiotron" Valves, Ducon Capacitors, etc., The National Electrical and Engineering Co., Ltd.

The Marconi Review Supplement to Vol. XIX, No. 103—Marconi Telegraph Co., Ltd., England—Commemorating the Jubilee of the first Transatlantic Wireless Signal, December 12th, 1901. (Amalgamated Wireless (A/sia) Ltd.).

The Measurement of Noise Factor, Marconi Instrument Ltd. (Amalgamated Wireless (A/sia) Ltd.).

Measurements by Q-Meter, Marconi Instruments Ltd. (Amalgamated Wireless (A/sia) Ltd.).

The Strowger Journal, October, 1951—Automatic Telephone and Electric Co., Ltd., England. (Automatic Telephone and Electric Co. (N.Z.), Ltd.).

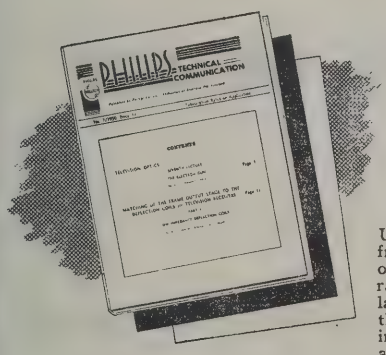
Philips Bulletin—Philips Electrical Industries of N.Z. Ltd.

Sylvania News, January, 1952—Sylvania Electric Products, Inc. (G. A. Wooller & Co., Ltd.).

AGA's Contribution to Engineering and Science, Svenska AB Gasaccumulator, Sweden. (W. S. Green & Co., Ltd.).

Radiotronics, March, 1952—Amalgamated Wireless Valve Co., Pty., Ltd.

Electrical Communication—International Telephone & Telegraph Corporation, U.S.A. (Standard Telephones & Cables Pty., Ltd., Wellington.)



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Consequently, we have pleasure in making the following introductory offer:—

One complete volume (6 copies) "Philips Technical Communication" 1950— 2/6 (usually 5/-)

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If you know a friend who would be interested in this offer, please send us his name and address.

Radioactive Isotopes for Industrial Radiography

A product from the atomic pile is to be used in New Zealand for gamma radiography in non-destructive testing and inspection of engineering materials. Equipment using this product is particularly suitable when examination is needed on the site of large-scale engineering constructional work. Radium and X-ray machines have been used by industrial organizations for many years.

A flaw in a piece of metal or in a weld can be detected by radiography in much the same way as a break in a bone or other flaws in the human machine. The industrial use of radiography, however, has been hindered by the cost of the equipment, and of X-rays by its bulk and relative immobility.

The developments of nuclear physics, however, have resulted in the availability of radioactive isotopes which are reported to be as effective as radium and can be obtained at a negligible fraction of the cost. Compared with radium, the rate of decay of their emission of gamma-rays is relatively fast, and they have to be returned to the atomic pile at regular intervals for reactivation. Like radium also, they are dangerous to handle; the operators must be properly trained in safety precautions, and the isotope sources, although themselves small, must always be carried in and used in conjunction with solid lead containers several inches thick, and be handled with tools several feet long.

The Dominion Physical Laboratory, Department of Scientific and Industrial Research, has recently acquired the facilities for doing gamma radiography, using the isotopes Cobalt-60 and Iridium-192, which have been procured from the Atomic Energy Research Establishment in England. These two isotopes have been selected in order to cover a useful range of penetration. In general, experience has shown that Cobalt-60 is most effective for thicknesses of two inches and more of steel—the rays are so penetrating that for thinner sections the radiograph lacks contrast. Conversely, Iridium-192 is not recommended for steel more than two inches thick because the radiation is less penetrating and the exposure times required are unduly long. Cobalt-60 retains a useful activity for several years; Iridium-192, however, lasts only a few months, and for the maintenance of a continuous service it is necessary to have two sources: one in use and one "reheating."

Where radiographic examination is required on easily portable specimens, industrial X-ray equipment (of which the Dominion Physical Laboratory has a unit working at up to 250,000 volts) usually offers the best and quickest method. But there are many situations where radiography has hitherto been impracticable, and where the portability of the isotope sources opens up new fields. Large machines or large castings, for example, cannot easily be brought to a fixed X-ray plant; and with large-scale engineering construction work, radiography is only possible if the equipment can be used on the site.

Inquiries have already been received about the use of the Dominion Physical Laboratory equipment in testing large pipes welded together at the site of a hydro power scheme. It is expected that the availability of radiographic facilities in this new portable and inexpensive form will make an important contribution to New Zealand industry.

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BOOK REVIEWS

"Philips Technical Communication"

Technical publications by the Philips organization are sufficiently well known now to require little introduction from a reviewer to the technical public at large, so that it is with pleasure that we welcome what to many will be a newcomer to the Philips library.

Actually, the "Philips Technical Communication" is not a book, in that it is a bi-monthly periodical. Those who know something about the vast scope of the Philips interests, inside the electronic field especially, will realize the wide variety of interesting technical topics to be found in the pages of this publication. Some of the material is reprinted from other Philips periodicals, such as the Technical Review, and the Research Reports, while a good deal of it is written by members of the Australian Philips staff. The periodical is, incidentally, produced in Australia. All the material is excellent, and can be expected to appeal to everyone seriously interested in electronics. There is a most excellent series of articles on electron optics, for instance, and there is much material that is of topical interest in view of the current pre-occupation here and in Australia with the possible advent of television. Amateur transmitters are not neglected, and there is some excellent material for them in the pages of Technical Communication. One particularly interesting article describes the design and construction of a 30-watt transmitter for the 420-260 mc/sec. amateur band, using the Philips equivalent of the better-known American type 829B, the QQE06/40.

All in all, this is a most attractive collection of information, and the reviewer, for one, will look forward to receiving his copy of the current issues.

P.H. Brans Vade-Mecum 1952

The 1952 edition of what has become known as "P. H. Brans" worthily keeps up the tradition of comprehensiveness initiated by its eight predecessors. Once more it is in one volume, but this time a rather radical change has been made in its arrangement. The publishers state that had they adhered to their previous practice of listing and classifying all electronic tubes, irrespective of type, then the new edition would have been a much larger and more expensive edition, of some 1,500 pages. Accordingly, the present (ninth) edition contains only reeciving and transmitting valves. It is intended later to print a tenth edition, which, together with the ninth, will cover all tubes, of whatever type. Because of this decision, the ninth edition does not contain any photo-cells, cathode

(Continued on Page 48.)

"RADIO AND ELECTRONICS"

LAB. PROTOTYPES

We have for disposal the following laboratory models that are no longer required by us, and which must be sold to cover the cost of components. All are in first-class working order, and complete descriptions of them will, of course, be found in back issues of "Radio and Electronics."

The 80-40-20 Bandspread Tuner

Complete in grey enamelled steel cabinet and with Eddystone full-vision dial. This outstanding unit gives complete bandspread on the above three amateur bands, and is more sensitive on 20 than on 80, thanks to the remarkable operating principle used in its circuit.

The 1951 V.H.F. Programme 6-Metre Receiver

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Non-Sinusoidal Waveforms

(Continued from Page 21.)

it is impossible for the grid voltage to rise more than just a few volts positive, no matter how high the input signal goes. Thus the plate current is also limited. The output will be a square wave. By properly choosing the values of the circuit elements, the limiting action may be made to occur over a wide range of signal amplitudes. Thus, it is possible to convert any complex waveform into a flat-topped waveform.

The circuit of Fig. 8, variously termed a diode clipper, performs a similar function. Any waveform applied at the input terminals will be clipped at a voltage level determined by the bias voltage in series with each diode. This circuit provides a simple method of converting a sine wave to a square wave. Diodes of either the vacuum tube type or the crystal type[5] may be employed.

REFERENCES

1—Aerovox Research Worker, June, 1950.

2—RCA Publication, "Cathode Ray Tubes and Allied Types."

3—"Principles of Television Engineering," D. G. Fink. Page 155.

4—Aerovox Research Worker, November, 1940.

5—Aerovox Research Worker, May, 1950.

The 78/L.P. Special

(Continued from Page 13.)

feedback resistor to use can be worked out from the relation :—

$$R_{22} = 400\sqrt{\frac{Z}{15}}$$

where Z is the actual speaker impedance. For example, should the speaker be one of 7.5 ohms, R_{22} will come down to 283 ohms.

High-Gain Pre-Selector

(Continued from Page 7.)

tortion disappears. It was unfortunately not possible to fit a gain control, but this is not really essential, because in all situations where the pre-selector is really being used for its advantages, it is best to have it set at maximum gain in any case.

Book Reviews

(Continued from Page 47.)

ray tubes, crystal diodes, magnetrons, klystrons, or other special electronic tubes. While this is to be regretted, it certainly makes the volume considerably easier to use, and after all, by far the most use for the volume is in looking up standard receiving and transmitting types. Because of the omission of all special tubes, the old system of separate classification into great tables of triodes, pentodes, etc., has been discontinued. The book consists of a single list in which valve types appear in numerical and alphabetical order, thus making it very simple to use. In order to give a quick description of an unknown type of valve, a simple code system has been used to classify the valves, and this works mostly according to the number of electrodes, but with simple addition which enables transmitting tubes to be readily distinguished from receiving ones. It is to be hoped that the companion tenth edition is published quite soon, because it seems that the two volumes together will make the most valuable reference work yet produced in this class. We are indebted by Messrs Technical Books Ltd. for our review copy.

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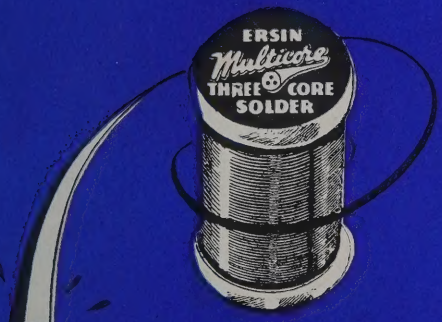

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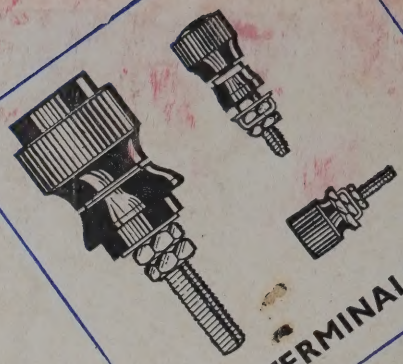

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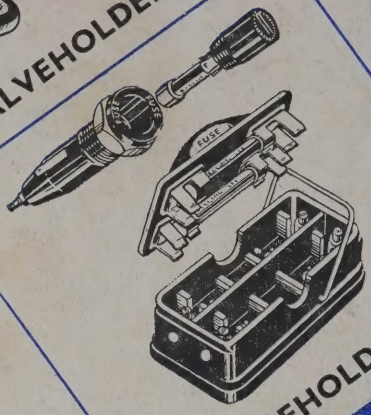

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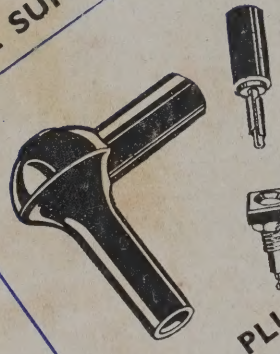

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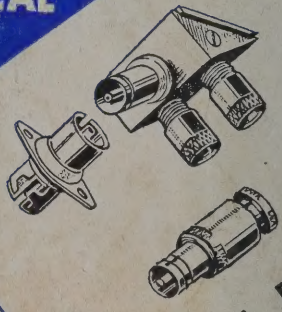

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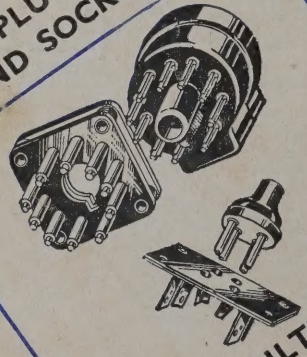

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